



THE UNIVERSITY OF QUEENSLAND
A U S T R A L I A

**The Lifestyle Triple P multilevel system of parenting and family support for
the prevention and treatment of childhood obesity.**

Jessica Anne Bartlett

BSc. (Hons I)

A thesis submitted for the degree of Doctor of Philosophy

at The University of Queensland in 2016

School of Psychology

Abstract

Childhood obesity rates are on the rise worldwide. The myriad of physical and psychological health consequences associated with childhood obesity is staggering. Emphasis must be placed on addressing this public health dilemma from both a preventative and treatment perspective.

Evidence-based parent-centered interventions are a potentially effective way to target childhood obesity. Parents play a key role in a child's lifestyle habits, and research has demonstrated that interventions involving parents are more effective than interventions exclusively targeting the child. Despite this, recruitment of parents into obesity-specific programs has been problematic. This challenge must be addressed from a population health framework if improvements in childhood obesity rates are to be achieved.

This thesis provides a framework for the prevention and management of childhood obesity from a public health perspective. Two randomised controlled trials are presented. First, a trial of a brief universal parenting program for the prevention of childhood obesity (Lifestyle Triple P Seminar Series); and second, a trial of an intensive 14-session parenting program for children who are already overweight or obese (Group Lifestyle Triple P). Support will be provided for a public health multilevel model of parenting support that blends a targeted intervention for overweight and obese children, with a universal brief preventative intervention for all children regardless of weight status.

Chapter 1 discusses the increased prevalence rates and considerable health risks associated with childhood obesity. The complex aetiology of obesity development will be described within a socio-ecological perspective. The research evidence supporting a multicomponent parent-centered approach to childhood obesity management will be presented. The shortage of well-controlled research trials evaluating such programs will be highlighted.

Chapter 2 details the rationale for a public health approach to preventing and treating childhood obesity. It describes the Lifestyle Triple P multilevel system, and reviews the existing evidence-

base for these interventions. Future research needs and challenges associated with a public health approach to parenting support will be discussed.

Chapter 3 evaluates the effectiveness of a new universal parenting program for obesity prevention in a randomised controlled trial (RCT) with a 12-month follow up. The Lifestyle Triple P Seminar Series targets all parents regardless of child weight status. It is designed as a health promotion tool to engage parents on a population level, and increase healthy parenting practices in general and lifestyle-specific domains. A combination of self-report and objective assessment measures was used to investigate intervention outcomes from pre-intervention, post-intervention, 6-months and 12-months follow-up. Following the intervention, there were significant improvements in overall dysfunctional parenting style, laxness, verbosity and overreactivity, both lifestyle-specific and general parental confidence, and child lifestyle problem behaviour at 12 months follow-up. The results of this RCT support its role as a preventative intervention for childhood obesity within a public health model of parenting support.

Chapter 4 is a RCT evaluating the efficacy of a multidisciplinary program which combined an evidence-based program for parents of children who are already overweight or obese (Group Lifestyle Triple P) with a family camp (Active Scouts Camp) program and dietetic consultations. Parents were randomly allocated to intervention or care as usual conditions. Outcomes on child body size, parenting and child behaviours, and serological data were assessed. The program resulted in significant improvements in multiple indices of child body size at 6-months follow-up, including body mass index *z*-scores and weight *z*-scores. There was a reduction in dysfunctional parenting styles in the intervention condition. Weight *z*-score improvements were maintained at 12-months follow-up. Research findings support the use of a multidisciplinary, family-centered approach to treating children with obesity.

The final chapter will discuss the implications of the thesis findings, and the recommended future directions for childhood obesity practice and research. The need for population-level research

of evidence-based parenting programs will be advocated in order to shift population level rates of childhood obesity.

Declaration by Author

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly authored works that I have included in my thesis.

I have clearly stated the contribution of others to my thesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, and any other original research work used or reported in my thesis. The content of my thesis is the result of work I have carried out since the commencement of my research higher degree candidature and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution. I have clearly stated which parts of my thesis, if any, have been submitted to qualify for another award.

I acknowledge that an electronic copy of my thesis must be lodged with the University Library and, subject to the policy and procedures of The University of Queensland, the thesis be made available for research and study in accordance with the Copyright Act 1968 unless a period of embargo has been approved by the Dean of the Graduate School.

I acknowledge that copyright of all material contained in my thesis resides with the copyright holder(s) of that material. Where appropriate I have obtained copyright permission from the copyright holder to reproduce material in this thesis.

Publications during candidature

Published/accepted peer-reviewed journal articles

No publications.

Conference presentations

Bartlett, J. A. & Sanders, M. R. (2016). Promoting a healthy home environment: an example of a public health approach to childhood obesity prevention and treatment. Presented at the Social Science of Obesity Workshop. Sydney, Australia.

Bartlett, J. A., Sanders, M. R., & Leong, G. M. (2013). *Positive Parenting for Healthy Living*. Poster presented at the Helping Families Change Conference. Los Angeles, United States.

Bartlett, J. A., Sanders, M. R., & Leong, G. M. (2014). *Empowering families to shift health, not weight: the Lifestyle Triple P Positive Parenting Program*. Poster presented at the International Congress on Obesity. Kuala Lumpur, Malaysia.

Bartlett, J. A., Sanders, M. R., & Leong, G. M. (2014). *Randomised clinical trial of a family-based lifestyle intervention: the Lifestyle Triple P Seminar Series*. Poster presented at the Helping Families Change Conference. Sydney, Australia.

Bartlett, J. A. & Sanders, M. R. (2012). *Lifestyle Triple P: Positive Parenting for Healthy Living*. Symposium presented at the Australia & New Zealand Obesity Society Conference. Auckland, New Zealand.

Bartlett, J. A. & Sanders, M. R. (2014). *Triple P - Positive Parenting Program*. Presented at the Allied Psychological Services (ATAPS) seminar. Brisbane, Australia.

Publications included in the thesis

No publications included. Only papers due to be submitted for publications have been included as thesis chapters.

Contributions by others to the thesis

My advisors, Matthew Sanders and Gary Leong, contributed to the conception and design of the research, and provided critical feedback on written work. Meera Lakhani assessed video recordings of sessions for protocol adherence on the Lifestyle Triple P Seminar RCT. The following individuals assisted with conducting and organising assessments and group sessions for the Lifestyle Triple P Seminar RCT: Meera Lakhani, Lucinda Hinckfuss, Claudia Sparti, Camille Fitzgerald, Elisa Jones, Jessica Miller, Madeline Stoddart, Norman Ramos, Hayley Dunne, Sabina Dzafic, Jessica Hearn, and Jasmine Kelly. Belinda Lipscombe, Ruby Clarke, and Michele Jordan delivered the intervention to the control parents.

Gary Leong, Doune Macdonald, Laura Desha, Anne Poulsen and Rebecca Abbott designed and collected data for the KOALA RCT. Laura Desha helped in the running of the KOALA Active Camps with Scouts QLD. The KOALA study coordinators, Denise Mitchell and Regina Dowdle, were involved in administrative duties, data assessment and entry, and co-ordination of intervention delivery. Statistical advice was sought regarding planning of various data analyses from Jamin Day.

Statement of parts of the thesis submitted to qualify for the award of another degree

None.

Acknowledgements

I would like to thank my primary supervisor, Professor Matthew Sanders, for his support and guidance. You have been an inspirational force behind this project, and your enthusiasm and positive attitude has been invaluable. You have shaped me into the clinician and researcher that I am today, and fostered my love for helping families and children to make a difference in their lives. To my secondary supervisor, Dr. Gary Leong, thank you for all your assistance with revising manuscripts and the opportunity to be part of the KOALA Mater Healthy Living project.

Thank you to Sherryn Davies and the team at Medicare Local for your support with delivery of the program to parents in Ipswich.

Thank you to all the research assistants that have worked on the Lifestyle Triple P project. I hope that you have gained valuable research and clinical experience from participation, and I am grateful that you chose to offer your valuable time. Thank you to Jamin Day for all your support with data analysis. Cassandra Rotolone and Georgina Churchill – you are amazing individuals volunteering your time to help me out when I needed you most. I am truly grateful.

Mum, you have been my rock throughout the entire thesis, and your belief in my abilities and never-wavering support has kept me on track. Dad – thank you dearly for all your support you have given me on this project. You are an amazingly generous and giving human. All the hours you spent proofing my document was a godsend. To Bob and Gail, thank you for always being available to help out with Oliver and taking Bella for walks. I would not have been able to get this doctorate completed without your constant support.

To my darling husband, thank you for always believing in me and supporting me. You are a constant source of stability and love, and I am very lucky to have you by my side. Thank you to my darling Oliver for being a constant grounding force in my life, and Delilah for your patience and presence.

Finally, to all the families who participated in the project I am truly amazed at your dedication to your families and children. Over 1000 assessment sessions with all of you and 640 online surveys! Thank you for completing your assessment and continuing to support the project. I wish you the best of luck in the future and hope your families remain happy and healthy using the Triple P strategies.

Keywords

Childhood obesity, Lifestyle Triple P, Triple P, parenting, behavioural family intervention, randomised controlled trial, evidence-based parenting program, population health.

Australian and New Zealand Standard Research Classifications (ANZSRC)

ANZSRC code: 170106, Health, Clinical and Counselling Psychology 90%

ANZSRC code: 170102, Developmental Psychology and Ageing 10%

Fields of Research (FoR) Classification

FoR code: 1701, Psychology, 100%

Table of Contents

Abstract.....	ii
Declaration by Author	v
Publications during candidature	vi
Publications included in the thesis	vii
Contributions by others to the thesis	vii
Acknowledgements	viii
Keywords	ix
Australian and New Zealand Standard Research Classifications (ANZSCR).....	ix
Fields of Research (FoR) Classification	ix
List of Tables and Figures.....	xii
List of Abbreviations	xiii
Chapter 1: General Introduction.....	1
Overview	2
Obesity: the global epidemic	2
Aetiology of childhood obesity	5
Dietary intake	6
Physical activity.....	7
Screen-based behaviour	8
Parenting.....	9
Socio-ecological model of childhood obesity	10
Management approaches	11
Research aims	12
References	14
Chapter 2: A population approach to parenting support for childhood obesity: the Lifestyle Triple P multilevel system	28
Abstract.....	29
Introduction	30
The rationale for a population approach to childhood obesity	30
Lifestyle Triple P – parenting as a population health priority	33
The Lifestyle Triple P evidence base	35
How a population health approach to parenting works	38
Conclusion.....	41
References	43
Chapter 3: Randomised controlled trial of Triple P for healthy living: The Lifestyle Triple P Seminar Series	52
Abstract.....	53
Background.....	55
Methods	56
Procedure	57
Intervention.....	58
Protocol adherence	59
Outcome measures.....	59
Statistical analyses.....	63
Results	64
Discussion.....	68
Conclusion.....	71
References	72

Chapter 4: Kinder Overweight Activity Lifestyle Actions (KOALA) Healthy Lifestyle Program for children with obesity: A randomised controlled trial.....	86
Abstract.....	87
Introduction	88
Methods	90
Randomisation	91
Intervention.....	91
Care as usual condition.....	93
Outcome measures.....	93
Procedure.....	96
Results	96
Discussion.....	101
Conclusions	103
References	105
Chapter 5: General Discussion and Conclusions	116
Summary.....	117
Major conclusions	117
Limitations of the current program of research.....	119
Future recommendations for researchers.....	120
Future recommendations for clinicians	123
Implications for policy	125
Final Comment	126
References	127

List of Tables and Figures

Chapter 1: General Introduction.

Figure 1. Global prevalence of overweight and obesity by sex in developed and developing countries in children and adolescents (ages 2-19 years) from 1980 to 2013.....	3
Figure 2. Diagram of the medical and psychological complications associated with childhood obesity.....	5
Figure 3. An aetiological model for the development of childhood overweight and obesity, including the potential modifiable targets for intervention.....	11

Chapter 2. A population approach to parenting support for childhood obesity: the Lifestyle Triple P multilevel system.

Figure 4. The Lifestyle Triple P multilevel system of graded reach and intensity of parenting and family support services for childhood obesity, alongside the broader Triple P multilevel system.	34
Table 1. The Lifestyle Triple P multilevel system of parenting and family support for childhood obesity.....	49
Figure 6. Illustration of the range of variables that can be targeted to facilitate engagement by particular parent groups.	50

Chapter 3. Randomised controlled trial of Triple P for healthy living: The Lifestyle Triple P Seminar Series.

Table 2. Demographic characteristics of the intervention and control group.....	77
Figure 7. CONSORT diagram of flow of participants.....	80
Table 3. Intervention effects for parent and child outcomes by condition	82
Table 4. Reliable change for Time 1 to Time 4.	84

Chapter 4. Kinder Overweight Activity Lifestyle Actions (KOALA) Healthy Lifestyle Program for children with obesity: A randomised controlled trial.

Figure 8. CONSORT diagram of flow of participants.....	110
Table 5. Demographic characteristics of the sample by condition	111
Table 6. Intervention effects for the intervention and CAU conditions at pre-intervention, post-intervention and 12-months follow-up.....	114

List of Abbreviations

<i>Abbreviation</i>	<i>Meaning</i>
ANCOVA	Analysis of Covariance
AUD	Australian Dollars
BMI	Body Mass Index
CAPES	Child Adjustment and Parenting Efficacy Scale
CAU	Care as Usual
CI	Confidence Interval
CSQ	Client Satisfaction Questionnaire
DASS	Depression Anxiety and Stress Scale
FBQ	Family Background Questionnaire
KOALA	Kinder Overweight Activity Lifestyle Actions
ITT	Intention to Treat
LBC	Lifestyle Behaviour Checklist
LPQ	Lifestyle Parenting Questionnaire
M	Mean
PPC	Parent Problem Checklist
PS	Parenting Scale
RCI	Reliable Change Index
RCT	Randomised Controlled Trial
RQI	Relationship Quality Index
SD	Standard Deviation
SDQ	Strengths and Difficulties Questionnaire
SE	Standard Error
Triple P	Positive Parenting Program

Chapter 1

General Introduction

Overview

Childhood obesity presents a major public health burden. The rising prevalence rates along with a plethora of research demonstrating the negative health consequences associated with obesity underscores the importance of developing public health strategies to address this problem. Health authorities worldwide are calling for effective interventions to combat this epidemic (World Health Organisation [WHO], 2012). The evidence for parent-centered interventions is well established, however parental recruitment into such programs remains a challenge. A universally available program promoting a healthy lifestyle is likely to be more relevant to parents, and complement intensive targeted interventions.

The following chapter will discuss childhood obesity in relation to prevalence, medical and psychological comorbidities, and aetiological factors. The rationale for parenting interventions will be provided, along with a discussion of the limitations of these programs. The public health implications will be outlined, and a rationale for the current dissertation will be provided.

Obesity: the global epidemic

The World Health Organisation (2012) defines obesity as an excess of body fat that may significantly impair health. Obesity is commonly defined using body mass index (BMI), which is weight (in kilograms) divided by height (in metres) squared. In the pediatric population, large variations in BMI due to pubertal status, age, and gender mean that age- and sex-specific BMI percentiles are used (Kuczmarski et al., 2000). Although definitions of overweight and obesity differ between studies, overweight will be defined as a BMI at or above the 85th percentile and below the 95th percentile, and obese will be classified as a BMI at or above the 95th percentile based on cutoffs published by Cole and colleagues (2000).

Childhood obesity has reached epidemic proportions worldwide, with 24% of males and 23% of females classified as overweight or obese in 2013 (Ng et al., 2013). In Australia, one of the highest rates of childhood obesity exists, with more than 25% of children aged 5-17 years classified as

overweight or obese (18% overweight, 8% obese; Australian Bureau of Statistics [ABS], 2012).

Figure 1 shows the substantial increases in child overweight and obesity rates for both developed and developing countries from 1980 to 2013 (Dehgran, Akhtar-Danesh, & Merchant, 2005; Ng et al., 2014). Although prevalence remains high, emerging evidence suggests that the rapid rise in obesity prevalence may be plateauing in some countries (e.g., Australia and the United States; Olds et al., 2011; Rokholm, 2010). Obesity rates in the adolescent population (Kelly et al., 2012), and the proportion of severely obese children (i.e., above the 99th BMI percentile) is still on the rise (Garnett, Baur, Jones & Hardy, 2006). The prevalence of being above a healthy weight is higher for children from socioeconomically disadvantaged groups, with around 30% of children in these groups being overweight or obese compared with around 20% in those with higher socioeconomic status (Hardy, King, Espinel, Cosgrove & Bauman, 2011).

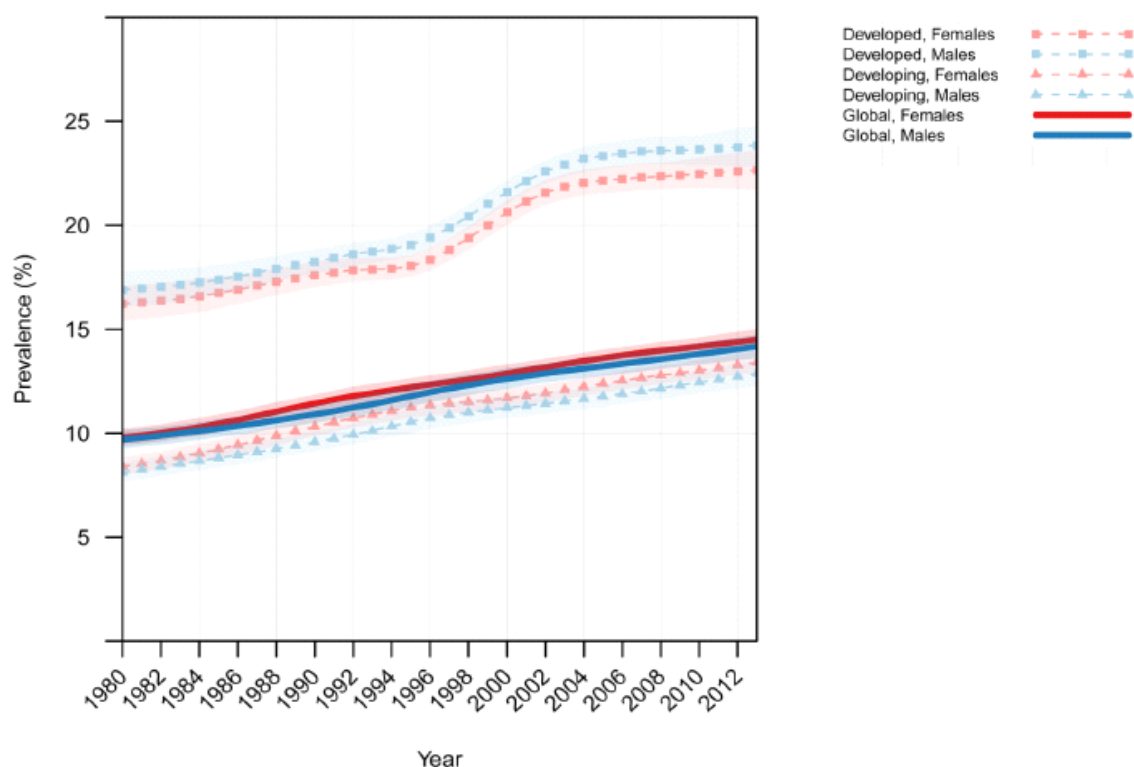


Figure 1. Global prevalence of overweight and obesity by sex in developed and developing countries in children and adolescents (ages 2-19 years) from 1980 to 2013. Based on International Obesity Task Force (IOTF) cutoffs. Source: taken from Ng and colleagues (2014).

The rise in the prevalence of obesity in the adult population has resulted in a steady increase in government expenditure in this sector. The adverse effects of obesity in adult life have been well documented, with higher rates of type 2 diabetes mellitus, cardiovascular disease, hypertension, osteoarthritis, gout, cancers and polycystic ovarian syndrome (Brown, Fujioka, Wilson & Woodworth, 2009; Guh, Zhang, Bansback, Amarsi, Birmingham, & Anis, 2009; Prospective Studies Collaboration, 2007). Obesity is recognised as one of the leading factors contributing to mortality (Prospective Studies Collaboration, 2009).

Obesity in childhood commonly persists into adolescence and adulthood. Research has shown that 75% of obese children remain obese as adults (James, 2004), and become more obese as adults than those with adult onset obesity (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001). Obese children also have higher risks of cardiovascular disease (Park, Falconer, Viner, & Kinra, 2012), metabolic conditions such as type 2 diabetes mellitus and fatty liver disease (Cruz, Shaibi, Weigensberg, Spruijt-Metz, Ball & Goran, 2005), obstructive sleep apnoea (Narang & Mathew, 2012), asthma (Egan, Ettinger & Bracken, 2013), and bone and joint problems (Napolitano, Walsh, Mahoney, & McCrea, 2000). Emerging evidence suggests that even very young children who are overweight exhibit signs of adverse health effects, including elevated blood pressure and impaired blood glucose metabolism (Gardner, Hosking, Metcalf, Jeffery, Voss & Wilken, 2009; Sorof & Daniels, 2002). In addition to these physical issues, children with excess body fat are exposed to psychosocial comorbidity, emotional and physical bullying and social exclusion (Griffiths, Wolke, Page, Horwood, & Alspac, 2006; Hayden-Wade et al., 2005). Higher weight status in 5-year-old girls is associated with lower self-concept (Davison & Birch, 2001a; Williams, Fournier, Coday, Richey, Tylavsky & Hare, 2013). Figure 2 outlines the significant medical and psychosocial comorbidities associated with childhood obesity.

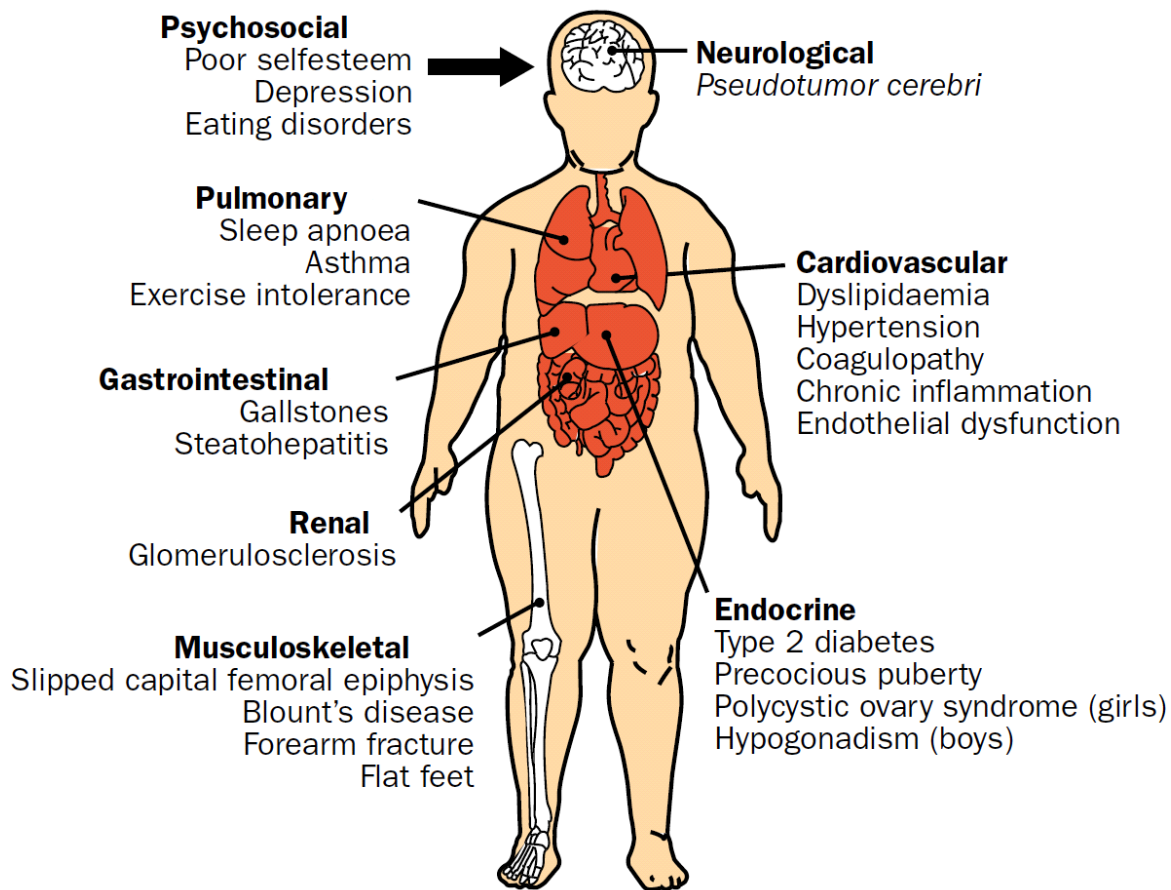


Figure 2. Diagram of the medical and psychological complications associated with childhood obesity. Source: taken from Ebbeling, Pawlak and Ludwig (2002).

In 2008, the total cost of obesity arising from disability, loss of well being and associated death in Australia was estimated to be \$58.2 billion, up from \$21 billion in 2005 (Crowle & Turner, 2010). It is anticipated that this problem will continue to escalate into the future without appropriate preventative and treatment measures.

Aetiology of childhood obesity

It is generally accepted that obesity results when energy intake exceeds energy expenditure (Butte, Christiansen, & Sorensen, 2012; Hill, Wyatt, & Peters, 2012). The aetiology of childhood obesity relates to genetic influences, disease processes, and environmental influences.

A child's genetic predisposition can influence the development of childhood obesity. A review of twin studies revealed that 30% to 70% of variation in body mass index (BMI) between individuals

is genetically predetermined (Min, Chiu, & Wang, 2013; Koeppen-Schomerus, Wardle, & Plomin, 2001). Genome-wide association studies (GWAS) in large populations have confirmed the small but significant contribution of multiple regions of the genome to BMI (Chesi & Grant, 2015). Disease processes, such as Prader-Willi Syndrome or thyroid and other endocrine disorders, can contribute to obesity, however they are rare as a primary cause of obesity (Sikaris, 2004).

Several environmental factors have been identified as exerting an influence on a child's later weight gain. These include parental obesity (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997), maternal smoking habits (Wojcik & Mayer-Davis, 2010), rapid weight gain during pregnancy (Oken, Taveras, Kleinman, Rich-Edwards, & Gillman, 2007), and high birth weight (Mitchell et al., 2016). Breastfeeding appears to have a protective effect (Owen, Martin, Whincup, Smith & Cook, 2005; Harder, Bergmann, Kallischnigg, & Plagemann, 2005).

Whilst the above aetiologies are important, many are unavoidable and unable to be addressed by intervention. Genetic predisposition is largely preset, however an obesogenic environment may amplify this predisposition.

Dietary intake

The dietary intake of Australian children has dramatically changed over the past 20 years. There has been a rise in consumption of energy dense and nutrient poor food (Sanigorski, Bell, Kremer, & Swinburn, 2005). Internationally, children are consuming more soft drinks (Millar et al., 2014). There has also been a decline in home-prepared foods and an increase in pre-packaged and fast food takeaway meals given to children (Poti & Popkin, 2011; Stuckler, McKee, Ebrahim, & Basu, 2012). Another trend has been a decrease in fruit and vegetable intake, with only 4% of the population meeting recommended number of serves for vegetables and 31% meeting the recommended serves for fruit (ABS, 2012). There is evidence that fruit and vegetable consumption has a protective effect against some childhood illnesses (Antova et al., 2003), the risk of cardiovascular disease (Robertson et al., 2004) and some cancers (Maynard et al., 2003).

There is growing evidence in adults that consumption of energy-dense foods is positively correlated to excess weight (Hartline-Grafton, Rose, Johnson, Rice & Webber, 2009; Kant & Graubard, 2005; Ledikwe et al., 2006), and that diets that reduce energy intake produce weight loss (Ello-Martin, Roe, Ledikwe, Beach, & Rolls, 2007; Flood et al., 2009; Raynor, Van Wallegen, Bachman, Looney, Phelan, & Wing, 2011). Evidence in relation to children is less clear. It seems likely that a similar relationship would apply, however research to date has failed to demonstrate a consistent link between energy intake and BMI in children (Elliot et al, 2011; Fulton, Dai, Steffen, Grunbaum, Shah, & Labarthe, 2009; Hebestreit et al., 2016). This may be due to limitations in research design. Parental self-report of food intake is prone to bias, and cross-study differences in assessing body fat exist (e.g. skinfold thickness versus BMI).

There is more convincing evidence that certain types of energy dense and nutrient poor foods are related to childhood obesity. Soft drinks and sugar-sweetened beverages have been associated with the development of increased body weight in children (Libuda & Kersting, 2009; Vartanian, Schwartz, & Brownell, 2007). Fast-food consumption also has an association with increased BMI (Braithwaite et al., 2014; Rosenheck, 2008).

Other dietary risk factors associated with excess weight gain include increased meal frequency (Toschke, Küchenhoff, Koletzko, & von Kries, 2005), and meal skipping (Toschke, Andre, & von Kries, 2009). Potential protective factors consist of eating a healthy breakfast (Szajewska & Ruszczynski, 2010), eating small evening meals (Thompson et al., 2006), and eating as a family (Hammons & Fiese, 2011).

Physical activity

There has been a reduction in the physical activity levels of children over recent decades. Only 19% of children engage in the recommended 60 minutes of daily physical activity (ABS, 2012). Childhood activity levels are likely to play a role in the development of obesity.

Physical activity is an important factor in adult weight loss maintenance (Fogelholm & Kukkonen-Harjula, 2000). A common finding in cross-sectional research is that inactive children

are more likely to be overweight or obese (Planinsec & Matejek, 2004; Trinh, Campbell, Ukoumunne, Gerner, & Wake, 2013; Trost, Kerr, Ward, & Pate, 2001). However, this finding contrasts with the inconclusive results reported in intervention research (Fogelholm & Kukkonen-Harjula, 2000). The limited number of randomised controlled trials evaluating structured physical activity regimes with children has shown a beneficial effect on body size (Atlantis, Barnes, & Fiatarone Singh, 2006). The limitations of research in relation to physical activity are likely to relate to the differing patterns of childhood activity when compared with adult activity. Child physical activity is often short with intermittent bouts of vigorous activity making it difficult for parents to quantify (Welk, Wood, & Morss, 2000). Objective measures are likely to produce more consistent findings. Examples of such measures include accelerometers (which measure acceleration and movement), pedometers (which measure steps and estimate distance walked), and the doubly labelled water technique (which involves periodic sampling of body fluids to estimate total energy expenditure and activity-related energy expenditure; for a review, see Strath et al., 2013).

Screen-based behaviour

The Australian Government's Department of Health and Ageing (2014a; 2014b) recommends less than 2 hours of screen-based activity per day for children aged 5 – 18 years, and less than 1 hour for 2 – 5 year olds. Screen-based activity include television, video and DVD viewing, computer and Internet use, and other electronic game use. In 2011, a staggering 70% of Australian children between 5 and 17 years old were above the recommended level of daily screen time (ABS, 2011).

Some studies have found a small but significant positive association between television viewing and BMI (Braithwaite et al., 2013; Eisenmann, Barte, Smith, Welk & Fu, 2008). However, other research has failed to find such an association in similar age groups (Bernard, Lavalley, Gray-Donald, & Deslisie, 1995; McMurray et al., 2000). Meta-analyses have highlighted such differences in results, but have concluded that a relationship between television viewing and BMI

seems likely. Interventions have demonstrated small effect sizes through a reduction of screen time behaviour (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004; Hancox & Poulton, 2006; Robinson, 1999). Most research in this area tends to focus on television viewing as the behaviour of interest, and fails to include time spent in other screen-based behaviours. This may lead to an underestimation of the total time spent in screen-based entertainment. The adverse affects of screen time could be enacted through a reduction of activity levels, increased energy intake through passively consuming energy-dense foods during screen time (Wiecha, Peterson, Ludwig, Kim, Sobol, & Gortmaker, 2006), and increased exposure to obesogenic advertising (Hills, Andersen, & Byrne, 2011).

Parenting

Parenting practices influence many areas of a child's health and wellbeing. This is particularly relevant in relation to eating habits and activity levels.

Parents serve as role models. There is a strong association between dietary intake of parents and their child. Parental intake of fruit, vegetables, sugar-sweetened beverages, and high fat foods has been positively associated with child intake (Pearson, Biddle, & Gorely, 2008; Raynor et al., 2011; van der Horst et al., 2007). A similar association has also been found between parent activity levels and that of their child. Active parents tend to raise active children (Hinkley, Crawford, Salmon, Okely, & Hesketh, 2008; Mattocks, Ness, Deere, Tilling, Leary, Blair, & Riddoch, 2008). One study found that children of active parents tend to be up to five times more active than those with inactive parents (More, Lombardi, White, Campbell, Oliveria, & Ellison, 1991).

The parent has the capacity to promote a healthy home environment. When healthy foods, such as fruits and vegetables, are available and accessible to children in the home, child intake of these foods subsequently increases (Cullen, Baranowski, Owens, Marsh, Rittenberry, & de Moor, 2003; Grimm, Harnack, & Story, 2004; Rasmussen et al., 2006). Children exhibit increased activity levels when their parents engage in active games with them (Sallis, Alcaraz, McKenzie, Hovell, Kolody, & Nader, 1992) and support physical activity behaviours (Gustafson & Rhodes, 2006). Providing

transportation to locations where physical activity is held also increases the activity levels of the child (Sallis, Alcaraz, McKenzie, Hovell, Kolody, & Nadar, 1992; Welk, Wood & Morss, 2003). Poor family functioning (i.e., with poor communication and high levels of conflict) is also associated with an increased risk of excess body weight (Halliday, Palma, Mellor, Green & Renzaho, 2014).

Parenting style has been associated with children's lifestyle patterns, and the risk of obesity (Davison & Birch, 2001b; Sleddens, Gerards, Thijs, De Vries, & Kremers, 2011). Authoritative parenting style is associated with a lower risk of obesity in children (Sleddens et al., 2011). Inadequate monitoring of the child's food intake can result in consumption of more energy dense foods and beverages (De Bourdeaudhuij et al., 2006), and decreased vegetable intake (Vereecken, Keukelier, & Maes, 2004). Failure to set reasonable limits on activity can result in more television viewing (Gentile & Walsh, 2002), and lower physical activity levels (Arredondo, Elder, Ayala, Campbell, Baquero & Duerksen, 2006). Conversely, stringent controls of dietary intake can compromise the child's ability to learn how to self-regulate eating, and may lead to overeating (Davison & Birch, 2001b; Faith, Scanlon, Birch, Francis & Sherry, 2004). The child's preference for and consumption of palatable foods has been found to increase when parents' restrict access to these foods (Clark, 2007).

There is a clear rationale for intervening with parents to promote a healthy home environment conducive to developing lifelong positive health habits. Parents influence their child's early lifestyle behaviours and health habits carried into adulthood. Maternal food preferences, timing of eating, and where food is consumed in the home is correlated with children's eating behaviours when they are adults (Benton, 2004).

Socio-ecological model of childhood obesity

The diverse aetiological factors contributing to childhood obesity have a wide reach into many facets of a child's environment. The socio-ecological approach considers the child as part of multiple complex inter-relating systems (Davison & Birch, 2001b). Figure 3 outlines the

aetiological model for childhood overweight and obesity, and highlights the risk and protective factors that are potential targets for intervention. The child is part of a family unit, which in turn interacts with local community and policy influences. The multifactorial nature of these influences makes the relative contribution of the causes of childhood obesity difficult to identify. Therefore, interventions and strategies must consider the complex interplay between the child and their family, within the broader context of society and be multicomponent in nature.

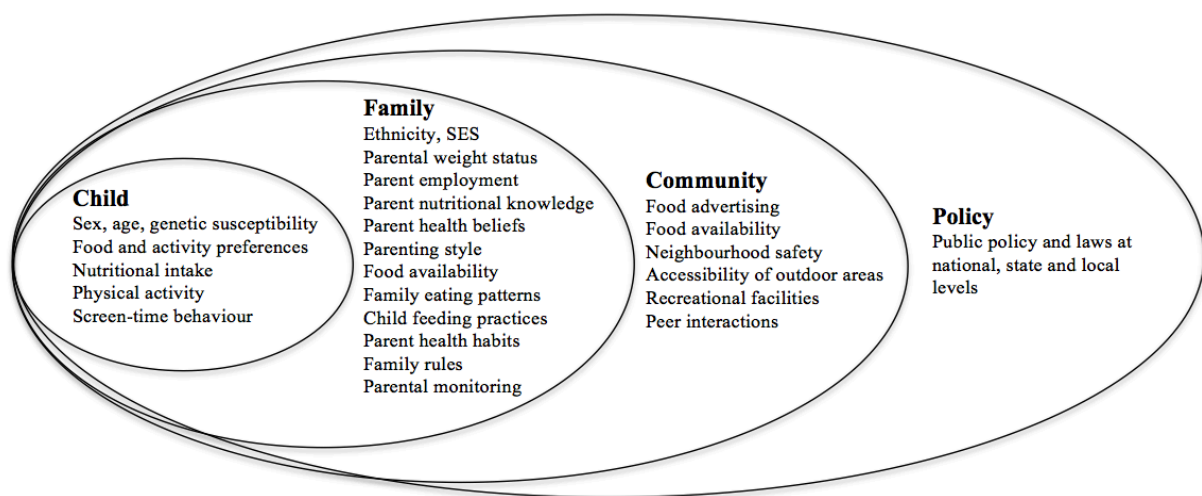


Figure 3. An aetiological model for the development of childhood overweight and obesity, including the potential modifiable targets for intervention. Source: adapted from Davison & Birch (2001b).

Management approaches

Parenting programs as vehicles for change

It is widely accepted that childhood obesity interventions should involve the family. Systematic reviews highlight the importance of targeting parents as agents for change in the treatment of obesity (Waters et al., 2011; Loveman et al., 2016). A recent Cochrane review suggested that interventions delivered to parents were as effective as parent-child interventions (Loveman et al., 2016). Parent-only interventions have shown better maintenance of treatment gains 7-years post-intervention compared to child-only interventions (Golan & Crow, 2004). A family-based approach

shifts the focus from child weight control to promoting parenting skills and confidence in establishing a home environment conducive to healthy living. This approach reduces the likelihood that the child feels targeted, which is likely to reduce the risk of inappropriate dietary restriction, weight preoccupation, and distorted body image (Davison & Birch, 2001a).

Limitations of current interventions

Despite the efficacy of lifestyle parenting interventions, many current childhood obesity prevention programs fail to focus on the parents as agents for change. When parents are targeted, it is often in rather indirect ways, such as newsletters sent home from school (Stice, Shaw, & Marti, 2006). Whilst some obesity prevention programs involve joint parent-child sessions, they rarely specifically target parental behaviour change (Davison, Lawson, & Coatsworth, 2012).

Recruitment of parents for childhood obesity programs remains a challenge (Gerards et al., 2012; Nguyen et al., 2012). Parents may fail to identify the relevance of obesity-specific interventions to their child (Gerards, Dagnelie, Jansen, De Vries, & Kremers, 2012). There is a clear disconnect in parental perceptions of child weight status and the child's actual weight, with 69% of parents incorrectly identifying their overweight or obese child as healthy weight (Jones, Parkinson, Drewett, Hyland, Pearce, & Adamson, 2011). Furthermore, when parents do correctly identify their child's weight status as a problem, they fail to identify weight as being a significant health issue for the child (Jones et al., 2011). Parents may feel concerned that identification of their child as being overweight will result in adverse effects on the child's self-esteem (Haynos & O'Donohue, 2012). There is little information in the literature identifying effective ways to engage parents in lifestyle interventions.

Research aims

The aim of this thesis is to propose a public health approach to childhood obesity that includes a blend of a targeted intensive intervention for parents of overweight and obese children, and a brief universal prevention seminar series for all parents regardless of child weight status. Two randomised controlled studies will be evaluated. Chapter 2 describes and examines the current

evidence-base for a public health approach to childhood obesity (the Lifestyle Triple P multilevel system). Chapter 3 evaluates the efficacy of a new universal parenting program (Lifestyle Triple P Seminar Series) in a RCT with four assessment time points and a 12-month follow-up. Chapter 4 evaluates the effectiveness of the Kinder Overweight Activity Lifestyle Actions (KOALA) Healthy Lifestyle Program, which combines an existing parent-centered obesity intervention (Group Lifestyle Triple P) with 3 overnight family camps (Active Scouts Camp) and dietetic consultations. The final chapter presents a discussion of the overall findings of the research, and proposes the limitations, practical implications and recommendations for future research.

References

- Antova, T., Pattenden, S., Nikiforov, B., Leonardi, G.S., Boeva, B., ... & Holikova, J. (2003). Nutrition and respiratory health in children in six central and eastern European countries. *Thorax*, 58, 231– 236.
- Arredondo, E. M., Elder, J. P., Ayala, G. X., Campbell, N., Baquero, B., & Duerksen, S. (2006). Is parenting style related to children's healthy eating and physical activity in Latino families? *Health Education Research*, 21, 862-871. doi: 10.1093/her/cyl110
- Atlantis, E., Barnes, E. H., & Fiatarone Singh, M. A. (2006). Efficacy of exercise for treating overweight in children and adolescents: A systematic review. *International Journal of Obesity*, 30, 1027-1040. doi: 10.1038/sj.ijo.0803286
- Australian Bureau of Statistics. (2011). *Australian Health Survey: Physical Activity, 2011-2012* (No. 4364.0.55.004). Canberra, ACT: Commonwealth of Australia.
- Australian Bureau of Statistics. (2012). *Australian Health Survey: updated results, 2011–2012*. (No. 4364.0.55.001). Canberra, ACT: Commonwealth of Australia.
- Benton, D. (2004). Role of parents in the determination of the food preferences of children and the development of obesity. *International Journal of Obesity*, 28, 858-869. doi: 10.1038/sj.ijo.0802532
- Bernard, L., Lavalley, C., Gray-Donald, K., & Deslisle, H. (1995). Overweight in Cree schoolchildren and adolescents associated with diet, low physical activity, and high television viewing. *Journal of American Dietetic Association*, 95, 800-802. doi: 10.1016/S0002-8223(95)00221-9
- Braithwaite, I., Stewart, A. W., Hancox, R. J., Beasley, R., Murphy, R., Mitchell, E. A., & the ISAAC Phase Three Study Group. (2013). Worldwide association between television viewing and obesity in children and adolescents: cross sectional study. *PlosOne*, 8, e74263-e74271. doi: 10.1371/journal.pone.0074263

- Braithwaite, I., Stewart, A. W., Hancox, R. J., Beasley, R., Murphy, R., Mitchell, E. A., & the ISAAC Phase Three Study Group. (2014). Fast-food consumption and body mass index in children and adolescents: an international cross-sectional study. *BMJ Open*, 4, e005-e813. doi:10.1136/bmjopen-2014-005813
- Brown, W. V., Fujioka, K., Wilson, P. W., & Woodworth, K. A. (2009). Obesity: why be concerned? *American Journal of Medicine*, 122, S4-S11. doi: 10.1016/j.amjmed.2009.01.002
- Butte, N. F., Christiansen, E., & Sorensen, T. I. A. (2012). Energy imbalance underlying the development of childhood obesity. *Obesity*, 15, 3056-3066. doi: 10.1038/oby.2007.364
- Chesi, A., & Grant, S. F. A. (2015). The Genetics of Pediatric Obesity. *Trends in Endocrinology & Metabolism*, 26, 711-713. doi: 10.1016/j.tem.2015.08.008
- Clark, H. R., Goyder, E., Bissell, P., Blank, L., & Peters, J. (2007). How do parents' child feeding behaviors influence child weight? Implications for childhood obesity policy. *Journal of Public Health*, 29, 132-141. doi: 10.1093/pubmed/fdm012
- Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal*, 320, 1240-1243.
- Crowle, J. & Turner, E. (2010). *Childhood obesity: An economic perspective*. Productivity Commission Staff Working Paper, Melbourne, VIC.
- Cruz, M. L., Shaibi, G. Q., Weigensberg, M. J., Spruijt-Metz, D., Ball, G. D. C., & Goran, M. I. (2005). Pediatric obesity and insulin resistance: Chronic disease risk and implications for treatment and prevention beyond body weight modification. *Annual Review of Nutrition*, 25, 435-469. doi: 10.1146/annurev.nutr.25.050304.092625
- Cullen, K. W., Baranowski, T., Owens, E., Marsh, T., Rittenberry, L., & de Moor, C. (2003). Availability, accessibility, and preferences for fruit, 100% fruit juice, and vegetables influence children's dietary behavior. *Health Education & Behavior*, 30, 615-626. doi: 10.1177/1090198103257254

Department of Health and Aging (2014a). *Make Your Move – Sit Less, Be Active for Life*.

Australia's Physical Activity and Sedentary Behaviour Guidelines for 5-12 years. Retrieved from:

[http://www.health.gov.au/internet/main/publishing.nsf/content/F01F92328EDADA5BCA257BF0001E720D/\\$File/brochure/20PA/20Guidelines_A5_5-12yrs.PDF](http://www.health.gov.au/internet/main/publishing.nsf/content/F01F92328EDADA5BCA257BF0001E720D/$File/brochure/20PA/20Guidelines_A5_5-12yrs.PDF)

Department of Health and Aging (2014b). *Move and Play Every Day. National Physical Activity Recommendations for Children 0–5 years*. Retried from:

[http://www.health.gov.au/internet/main/publishing.nsf/content/F01F92328EDADA5BCA257BF0001E720D/\\$File/Move/20and/20play/20every/20day/200-5yrs.PDF](http://www.health.gov.au/internet/main/publishing.nsf/content/F01F92328EDADA5BCA257BF0001E720D/$File/Move/20and/20play/20every/20day/200-5yrs.PDF)

Davison, K. K., & Birch, L. L. (2001a). Weight status, parent reaction, and self-concept in five-year-old girls. *Pediatrics*, *107*, 146-153.

Davison, K. K., & Birch, L. L. (2001b). Childhood overweight: A contextual model and recommendations for future research. *Obesity Reviews*, *2*, 159-171. doi: 10.1046/j.1467-789x.2001.00036.x

Davison, K. K., Lawson, H. A., & Coatsworth, J. D. (2012). The family-centered action model of intervention layout and implementation (FAMILI): The example of childhood obesity. *Health Promotion Practice*, *13*, 454-461. doi: 10.1177/1524839910377966

De Bourdeaudhuij, I., Yngve, A., te Velde, S. J., Klepp, K. I., Rasmussen, M., Thorsdottir, I., ... Brug, J. (2006). Personal, social and environmental correlates of vegetable intake in normal weight and overweight 9 to 13-year old boys. *International Journal of Behavioral Nutrition and Physical Activity*, *3*, 37-46. doi: 10.1186/1479-5868-3-37

Dehgran, M., Akhtar-Danesh, N., & Merchant, A. T. (2005). Childhood obesity, prevalence and prevention. *Nutrition Journal*, *4*, 24-32. doi: 10.1186/1475-2891-4-24

Ebbeling, C. B., Pawlak, D. B., & Ludwig, D. S. (2002). Childhood obesity: public-health crisis, common sense cure. *Lancet*, *360*, 473-482. doi: 10.1016/S0140-6736(02)09678-2

- Egan, K., Ettinger, A., & Bracken, M. (2013). Childhood body mass index and subsequent physician-diagnosed asthma: a systematic review and meta-analysis of prospective cohort studies. *BMC Pediatrics*, *13*, 121. doi: 10.1186/1471-2431-13-121
- Eisenmann, J. C., Bartee, R. T., Smith, D. T., Welk, G. J., & Fu, Q. (2008). Combined influence of physical activity and television viewing on the risk of overweight in US youth. *International Journal of Obesity (London)*, *32*, 613-618. doi: 10.1038/sj.ijo.0803800
- Elliott, S. A., Truby, H., Lee, A., Harper, C., Abbott, R. A., & Davies, P. S. (2011). Associations of body mass index and waist circumference with: energy intake and percentage of energy from macronutrients, in a cohort of Australian children. *Nutrition Journal*, *10*, 58. doi: 10.1186/1475-2891-10-58
- Ello-Martin, J. A., Roe, L. S., Ledikwe, J. H., Beach, A. M., & Rolls, B. J. (2007). Dietary energy density in the treatment of obesity: a year-long trial comparing two weight-loss diets. *American Journal of Clinical Nutrition*, *85*, 1465-1477.
- Faith, M. S., Scanlon, K. S., Birch, L. L., Francis, L. A., & Sherry, B. (2004). Parent-child feeding strategies and their relationship to child eating and weight status. *Obesity Research*, *12*, 1711-1722. doi: 10.1038/oby.2004.212
- Freedman, D. S., Khan, L. K., Dietz, W. H., Srinivasan, S. R., & Berenson, G. S. (2001). Relationship of childhood obesity to coronary heart disease risk factors in adulthood: The Bogalusa Heart Study. *Pediatrics*, *108*, 712-718.
- Flood, A., Mitchell, N., Jaeb, M., Finch, E. A., Laqua, P. S., Welsh, E. M., ... & Jeffery, R. W. (2009). Energy density and weight change in a long-term weight-loss trial. *International Journal of Behavioural Nutrition and Physical Activity*, *6*, 57. doi: 10.1186/1479-5868-6-57
- Fogelholm, M., & Kukkonen-Harjula, K. (2000). Does physical activity prevent weight gain: A systematic review. *Obesity Reviews*, *1*, 95-111. doi: 10.1046/j.1467-789x.2000.00016.x

- Fulton, J. E., Dai, S., Steffen, L. M., Grunbaum, J. A., Shah, S. M., & Labarthe, D. R. (2009). Physical activity, energy intake, sedentary behavior, and adiposity in youth. *American Journal of Preventative Medicine*, 37, s40-s49. doi: 10.1016/j.amepre.2009.04.010
- Gardner, D. S. L., Hosking, J., Metcalf, B. S., Jeffery, A. N., Voss, L. D., & Wilkin, T. J. (2009). Contribution of early weight gain to childhood overweight and metabolic health: A longitudinal study (EarlyBird 36). *Pediatrics*, 123, e67-73. doi: 10.1542/peds.2008-1292
- Garnett, S. P., Baur, L. A., Jones, A. M., & Hardy, L. L. (2016). Trends in the prevalence of morbid and severe obesity in Australian children aged 7-15 years, 1985-2012. *PlosOne*, 11, 1-7. doi: 10.1371/journal.pone.0154879
- Gentile, D. A., & Walsh, D. S. (2002). A normative study of family media habits. *Applied Developmental Psychology*, 23, 157-178. doi: 10.1016/S0193-3973(02)00102-8
- Gerards, S. M. P., Dagnelie, P. C., Jansen, M. W. J., De Vries, N. K., & Kremers, S. P. J. (2012). Barriers to successful recruitment of parents of overweight children for an obesity prevention intervention: a qualitative study among health care professionals. *BMC Family Practice*, 13, 37. doi: 10.1186/1471-2296-13-37
- Golan, M., & Crow, S. (2004). Targeting parents exclusively in the treatment of childhood obesity: Long-term results. *Obesity Research*, 12, 357-361. doi: 10.1038/oby.2004.45
- Golan, M., Fainaru, M., & Weizman, A. (1998). Role of behavior modification in the treatment of childhood obesity with the parents as the exclusive agents of change. *International Journal of Obesity*, 22, 1217-1224.
- Griffiths, L. J., Wolke, D., Page, A. S., Horwood, J. P., & ALSPAC Study Team. (2006). Obesity and bullying: Different effects for boys and girls. *Archives of Disease in Childhood*, 91, 121-125. doi: 10.1136/adc.2005.072314
- Grimm, C. G., Harnack, L., & Story, M. (2004). Factors associated with soft drink consumption in school-aged children. *Journal of the American Dietetic Association*, 104, 1244-1249. doi: 10.1016/j.jada.2004.05.206

- Guh, D. P., Zhang, W., Bansback, N., Amarsi, Z., Birmingham, C.L., & Anis, A. H. (2009). The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. *BMC Public Health*, 9, 88. doi: 10.1186/1471-2458-9-88
- Gustafson, S. L., & Rhodes, R. E. (2006). Parental correlates of physical activity in children and early adolescents. *Sports Medicine*, 36, 79-97.
- Halliday, J. A., Palma, C. L., Mellor, D., Green, J., & Renzaho, A. M. N. (2014). The relationship between family functioning and child and adolescent overweight and obesity: a systematic review. *International Journal of Obesity*, 38, 480-493. doi: 10.1038/ijo.2013.213
- Hammons, A. J., & Fiese, B. H. (2011). Is frequency of shared family meals related to the nutritional health of children and adolescents? *Pediatrics*, 127, e1565-e1574.
- Hancox, R. J., & Poulton, R. (2006). Watching television is associated with childhood obesity: But is it clinically important? *International Journal of Obesity*, 30, 171-175. doi: 10.1038/sj.ijo.0803071
- Harder, T., Bergmann, R., Kallischnigg, G., Plageman, A. (2005). Duration of breastfeeding and risk of overweight: a meta-analysis. *American Journal of Epidemiology*, 162, 397-403. doi: 10.1093/aje/kwi222
- Hardy, L. L., King, L., Espinel, P., Cosgrove, C., & Bauman, A. (2011). *NSW Schools Physical Activity and Nutrition Survey (SPANS) 2010: Full Report*. Ministry of Health: Canberra, ACT.
- Hartline-Grafton, H. L., Rose, D., Johnson, C. C., Rice, J. C., & Webber, L. S. (2009). Energy density of foods, but not beverages, is positively associated with body mass index in adult women. *European Journal of Clinical Nutrition*, 63, 1411-1418. doi: 10.1038/ejcn.2009.102
- Hayden-Wade, H. A., Stein, R. I., Ghaderi, A., Saelens, B. E., Zabinski, M. F., & Wilfley, D. E. (2005). Prevalence, characteristics, and correlates of teasing experiences among overweight children vs. non-overweight peers. *Obesity Research*, 13, 1381-1392. doi: 10.1038/oby.2005.167

- Haynos, A. F. & O'Donohue, W. T. (2012). Universal childhood and adolescent obesity prevention programs: Review and critical analysis. *Clinical Psychology Review*, 32, 383-399. doi: 10.1016/j.cpr.2011.09.006
- Hebestreit, A., Barba, G., De Henauw, S., Eiben, G., Hadjigeorgiou, C., Kovacs, E., ... & Bornhorst, C. (2016). Cross-sectional and longitudinal associations between energy intake and BMI z-score in European children. *International Journal of Behavioural Nutrition and Physical Activity*, 13, 23-34. doi: 10.1186/s12966-016-0344-3
- Hills, A. P., Andersen, L. B., & Byrne, N. M. (2011). Physical activity and obesity in children. *British Journal of Sports Medicine*, 45, 866-870. doi: 10.1136/bjsports-2011-090199
- Hill, J. O., Wyatt, H. R., & Peters, J. C. (2012). Energy balance and obesity. *Circulation*, 126, 126-132. doi: 10.1161/2FCIRCULATIONAHA.111.087213
- Hinkley, T., Crawford, D., Salmon, J., Okely, A. D., & Hesketh, K. (2008). Preschool children and physical activity: a review of correlates. *American Journal of Preventative Medicine*, 24, 435-441. doi: 10.1016/j.amepre.2008.02.001
- James, P. T. (2004). Obesity: The worldwide epidemic. *Clinics in Dermatology*, 22, 276-280.
- Jones, A. R., Parkinson, K. N., Drewett, R. F., Hyland, R. M., Pearce, M. S., & Adamson, A. J. (2011). Parental perceptions of weight status in children: The Gateshead Millennium Study. *International Journal of Obesity*, 35, 953-962. doi: 10.1038/ijo.2011.106
- Kant, A. K., & Graubard, B. I. (2005). Energy density of diets reported by American adults: association with food group intake, nutrient intake, and body weight. *International Journal of Obesity*, 29, 950-960. doi: 10.1038/sj.ijo.0802980
- Kelly, A. S., Barlow, S. E., Rao, G., Inge, T. H., Hayman, L. L., ... & Daniels, S. R. (2013). Severe obesity in children and adolescents: identification, associated health risks, and treatment approaches: a scientific statement from the American Heart Association. *Circulation*, 128, 1689-1712. doi: 10.1161/CIR.0b013e3182a5cfb3

- Koeppen-Schomerus, G., Wardle, J., & Plomin, R. (2001). A genetic analysis of weight and overweight in 4-year-old twin pairs. *International Journal of Obesity*, 25, 838-844. doi: 10.1038/sj.ijo.0801589
- Kuczmarski, R. J., Ogden, C. L., Grummer-Strawn, L. M., Flegal, K. M., Guo, S. S., ... Johnson, C. L. (2000). *CDC growth charts: United States*. Hyattsville, MD: National Center for Health Statistics.
- Ledikwe, J. H., Blanck, H. M., Kettle Khan, L., Serdula, M. K., Seymour, J. D., Tohil, B. C., & Rolls, B. J. (2006). Dietary energy density is associated with energy intake and weight status in US adults. *American Journal of Clinical Nutrition*, 83, 1362-1368.
- Libuda, L., & Kersting, M. (2009). Soft drinks and body weight development in childhood: Is there a relationship? *Current Opinion in Clinical Nutrition*, 12, 596-600. doi: 10.1097/MCO.0b013e32833189f6
- Loveman, E., Al-Khudairy, L., Johnson, R. E., Robertson, W., Colquitt, J. L., ... & Rees, K. (2015). Parent-only interventions for childhood overweight and obesity in children aged 5 to 11 years. *Cochrane Database of Systematic Reviews*, 12, 1-205. doi: 10.1002/14651858.CD012008.
- Marshall, S. J., Biddle, S. J. H., Gorely, T., Cameron, N., & Murdey, I. (2004). Relationship between media use, body fatness and physical activity in children and youth: A meta analysis. *International Journal of Obesity*, 28, 1238-1246. doi: 10.1038/sj.ijo.0802706
- Mattocks, C., Ness, A., Deere, K., Tilling, K., Leary, S., Blair, S. N., & Riddoch, C. (2008). Early life determinants of physical activity in 11 to 12 year olds: cohort study. *BMJ*, 336, 26-34. doi: 10.1136/bmj.39385.443565.BE
- Maynard, M., Gunnell, D., Emmett, P., Frankel, S., & Davey Smith, G. (2003). Fruit, vegetables, and antioxidants in childhood and risk of adult cancer: the Boyd Orr cohort. *Journal of Epidemiological Community Health*, 57, 218-225. doi: 10.1136/2Fjech.57.3.218

- McMurray, R. G., Harrell, J. S., Deng, S., Bradley, C. B., Cox, L.M., & Bangdiwala, S. I. (2000). The influence of physical activity, socioeconomic status, and ethnicity on the weight status of adolescents. *Obesity Research*, 8, 130-139. doi: 10.1038/oby.2000.14
- Millar, L., Rowland, B., Nichols, M., Swinburn, B., Bennett, C., Skoutheris, H., & Allender, S. (2014). Relationship between raised BMI and sugar sweetened beverages and high fat food consumption among children. *Obesity*, 22, e96-e103. doi: 10.1002/oby.20665
- Min, J., Chiu, D. T., & Wang, Y. (2013). Variation in the heritability of body mass index on diverse twin studies: a systematic review. *Etiology and Pathophysiology*, 14, 871-882. doi: 10.1111/obr.12065
- Mitchell, E. A., Stewart, A. W., Braithwaite, I., Hancox, R. J., Murphy, R., Wall, C., Beasley, R., & ISACC Phase Three Study Group. (2016). Birth weight and subsequent body mass index in children: an international cross-sectional study. *Pediatric Obesity*. doi: 10.1111/ijpo.12138
- Moore, L. L., Lombardi, D. A., White, M. J., Campbell, J. L., Oliveria, S. A., & Ellison, R. C. (1991). Influence of parents' physical activity levels on activity levels of young children. *Journal of Pediatrics*, 118, 215-219. doi: 10.1016/S0022-3476(05)80485-8
- Napolitano, C., Walsh, S., Mahoney, L., & McCrea, J. (2000). Risk factors that may adversely modify the natural history of the pediatric pronated foot. *Clinics in Pediatric Medicine and Surgery*, 17, 397-417.
- Narang, I., & Mathew, J. L. (2012). Childhood obesity and obstructive sleep apnea. *Journal of Nutrition & Metabolism*, 2012, 1-8. doi: 10.1155/2012/134202
- Ng, M., Fleming, T., Robinson, M., Thomson, B., Graetz, N... & Gakidou, E. (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*, 384, 766-781. doi: 10.1016/S0140-6736(14)60460-8
- Nguyen, B., McGregor, K. A., O'Connor, J., Shrewsbury, V. A., Lee, A., Steinbeck, K. S., Hill, A. J., Shah, S., Kohn, M. R. & Baur, L. A. (2012). Recruitment challenges and recommendations

- for adolescent obesity trials. *Journal of Pediatrics and Child Health*, 48, 38-43. doi: 10.1111/j.1440-1754.2011.02183.x
- Olds, T., Maher, C., Shumin, S., Peneau, S., Lioret, S., ... & Summerbell, C. (2011). Evidence that the prevalence of childhood overweight is plateauing: data from nine countries. *International Journal of Pediatric Obesity*, 6, 342-360. doi: 10.3109/17477166.2011.605895
- Oken, E., Taveras, E. M., Kleinmann, K. P., Rich-Edwards, J. W., & Gillman, M. W. (2007). Gestational weight gain and child adiposity at age 3 years. *American Journal of Obstetrics and Gynecology*, 196, e1-e8. doi: 10.1016/2Fj.ajog.2006.11.027
- Owen, C. G., Martin, R. M., Whincup, P. H., Smith, G. D., & Cook, D. G. (2005). Effect of infant feeding on the risk of obesity across the life course: A quantitative review of published evidence. *Pediatrics*, 115, 51367-51377.
- Park, M. H., Falconer, C., Viner, R. M., & Kinra, S. (2012). The impact of childhood obesity on morbidity and mortality in adulthood: a systematic review. *Obesity Reviews*, 13, 985-1000. doi: 10.1111/j.1467-789X.2012.01015.x
- Pearson, N., Biddle, S. J. H., & Gorely, T. (2008). Family correlates of fruit and vegetable consumption in children and adolescents: a systematic review. *Public Health Nutrition*, 12, 267-283. doi: 10.1017/S1368980008002589
- Planinsec, J., & Matejek, C. (2004). Differences in physical activity between non-overweight, overweight and obese children. *Collegium Anthropologicum*, 28, 747-754.
- Poti, J. M., & Popkin, B. M. (2011). Trends in energy intake among US children by eating location and food source. *Journal of American Dietetic Association*, 111, 1156-1164. doi: 10.1016/j.jada.2011.05.007.
- Prospective Studies Collaboration. (2007). Blood cholesterol and vascular mortality by age, sex, and blood pressure: a meta-analysis of individual data from 61 prospective studies with 55,000 vascular deaths. *Lancet*, 370, 1829-1839. doi: 10.1016/S0140-6736(07)61778-4

- Prospective Studies Collaboration. (2009). Body-mass index and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. *Lancet*, 373, 1083-1096. doi: 10.1016/S0140-6736(09)60318-4
- Rokholm, B., Baker, J. L., & Sorenson, T. I. (2010). The levelling off of the obesity epidemic since the year 1999 – a review of evidence and perspectives. *Obesity Reviews*, 11, 835-846. doi: 10.1111/j.1467-789X.2010.00810.x
- Rasmussen, M., Krolner, R., Klepp, K-I, Lytle, L., Brug, J., Bere, E., & Due, P. (2006). Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies. *International Journal of Behavioural Nutrition and Physical Activity*, 3, 22-41. doi: 10.1186/1479-5868-3-22
- Raynor, H. A., Van Walleghe, E. L., Osterholt, K. M., Hart, C. N., Jelalian, E., Wing, R. R., & Goldfield, G. S. (2011). The relationship between child and parent food hedonics and parent and child food group intake in children with overweight/obesity. *Journal of American Dietetics Association*, 111, 425-430. doi: 10.1016/j.jada.2010.12.013.
- Raynor, H. A., Van Walleghe, E. L., Bachman, J. L., Looney, S. M., Phelan, S., & Wing, R. R. (2011). Dietary energy density and successful weight loss maintenance. *Eating Behaviour*, 12, 119-125. doi: 10.1016/j.eatbeh.2011.01.008
- Robertson, A., Tirado, C., Lobstein, T., Jermini, M., Knai, C., ... & James, W. (2004). *Food and Health in Europe: a new basis for action*. (European Series, No. 96). World Health Organisation Regional Office for Europe, Copenhagen.
- Robinson, T. N. (1999). Reducing children's television viewing to prevent obesity. *JAMA*, 282, 1561-1567. doi: 10.1001/jama.282.16.1561
- Rosenheck, R. (2008). Fast food consumption and increased caloric intake: a systematic review of a trajectory towards weight gain and obesity risk. *Obesity Reviews*, 9, 535-547. doi: 10.1111/j.1467-789X.2008.00477.x

- Sallis, J. F., Alcaraz, J. E., McKenzie, T. L., & Hovell, M. F. (1999). Predictors of change in children's physical activity over 20 months: Variations by gender and level of adiposity. *American Journal of Preventive Medicine*, 16, 222-229. doi: 10.1016/S0749-3797(98)00154-8
- Sallis, J. F., Alcaraz, J. E., McKenzie, T. L., Hovell, M. F., Kolody, B., & Nader, P. R. (1992). Parental behavior in relation to physical activity and fitness in 9-year-old children. *American Journal of Diseases of Children*, 146, 1383-1388. doi: 10.1001/archpedi.1992.02160230141035
- Sanigorski, A. M., Bell, A. C., Kremer, P. J., & Swinburn, B. A. (2005). Lunchbox contents of Australian school children: Room for improvement. *European Journal of Clinical Nutrition*, 59, 1310-1316. doi: 10.1038/sj.ejcn.1602244
- Sikaris, K. A. (2004). The Clinical Biochemistry of Obesity. *Clinical Biochemistry Review*, 25, 165-181.
- Sleddens, E. F. C., Gerards, S. M. P. L., Thijs, C., De Vries, N. K., & Kremers, S. P. J. (2011). General parenting, childhood overweight and obesity-inducing behaviours, a review. *International Journal of Pediatric Obesity*, 6, e12-e227. doi: 10.3109/17477166.2011.566339
- Sorof, J., & Daniels, S. (2002). Obesity hypertension in children: A problem of epidemic proportions. *Hypertension*, 40, 441-447.
- Stice, E., Shaw, H., & Marti, C. N. (2006). A meta-analytic review of obesity prevention programs for children and adolescents: The skinny on interventions that work. *Psychology Bulletin*, 132, 667-691. doi: 10.1037/2F0033-2909.132.5.667
- Strath, S. J., Kaminsky, L. A., Ainsworth, B. E., Ekelund, U., Freedson, P. S... & Swartz, A. M. (2013). Guide to the assessment of physical activity: clinical and research applications. *Circulation*, 128, 2259-2279. doi: 10.1161/01.cir.0000435708.67487.da
- Stuckler, D., McKee, M., Ebrahim, S., & Basu, S. (2012). Manufacturing epidemics: the role of global producers in increased consumption of unhealthy commodities including processed foods, alcohol, and tobacco. *Plos Medicine*, 9, e1001235. doi: 10.1371/journal.pmed.1001235

- Szajewska, H., & Ruszczynski, M. (2010). Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe. *Critical Reviews in Food Science and Nutrition*, 50, 113-119. doi: 10.1080/10408390903467514
- Thompson, O. M., Ballew, C., Resnicow, K., Gillespie, C., Must, A., Bandini, L. G., ... Dietz, W. H. (2006). Dietary pattern as a predictor of change in BMI z-score among girls. *International Journal of Obesity*, 30, 176-182. doi: 10.1038/sj.ijo.0803072
- Toschke, A. M., Andre, M., & von Kries, R. (2009). Meal frequency, breakfast consumption and childhood obesity. *International Journal of Pediatric Obesity*, 4, 242-248. doi: 10.3109/17477160902763341
- Toschke, A. M., Küchenhoff, H., Koletzko, B., & von Kries, R. (2005). Meal frequency and childhood obesity. *Obesity Research*, 13, 1932-1938. doi: 10.1038/oby.2005.238
- Trost, S. G., Kerr, L. M., Ward, D. S., & Pate, R. R. (2001). Physical activity and determinants of physical activity in obese and non-obese children. *International Journal of Obesity*, 25, 822-829. doi: 10.1038/sj.ijo.0801621
- Trinh, A., Campbell, M., Ukoumunne, O. C., Gerner, B., & Wake, M. (2013). Physical activity and 3-year BMI change in overweight and obese children. *Pediatrics*, 131(2), e470-e477. doi: 10.1542/peds.2012-1092
- van der Horst, K., Oenema, A., Ferreira, I., Wendel-Vos, Q., Giskes, K., van Lenthe, F., & Brug, J. (2007). A systematic review of environmental correlates of obesity-related dietary behaviors in youth. *Health Education Research*, 22, 203-226. doi: 10.1093/her/cyl069
- Vartanian, L. R., Schwartz, M. B., & Brownell, K. D. (2007). Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. *American Journal of Public Health*, 97, 667-675. doi: 10.2105/2FAJPH.2005.083782
- Vereecken, C. A., Keukelier, E., & Maes, L. (2004). Influence of mother's educational level on food parenting practices and food habits of young children. *Appetite*, 43, 93-103. doi: 10.1016/j.appet.2004.04.002

- Welk, G. J., Wood, K., & Morss, G. (2003). Parental influences on physical activity in children: An exploration of potential mechanisms. *Pediatric Exercise Science*, 15, 19-33.
- Whitaker, R. C., Wright, J. A., Pepe, M. S., Seidel, K. D., & Dietz, W. H. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *New England Journal of Medicine*, 337, 869-873. doi: 10.1056/NEJM199709253371301
- Wiecha, J. L., Peterson, K. E., Ludwig, D. S., Kim, J., Sobol, A., & Gortmaker, S. (2006). When children eat what they watch: impact of television viewing on dietary intake in youth. *Archives of Pediatrics & Adolescent Medicine*, 160, 436-442. doi: 10.1001/archpedi.160.4.436.
- Williams, N. A., Fournier, J., Coday, M., Richey, P. A., Tylavsky, F. A., & Hare, M. E. (2014). Body self-esteem, peer difficulties and perceptions of physical health in overweight and obese urban children aged 5 to 7 years. *Child: care, health and development*, 39, 825-834. doi: 10.1111/j.1365-2214.2012.01401.x
- Wojcik, K. J., & Mayer-Davis, E. J. (2010). *Pediatric Obesity: Weight gain, smoking and breastfeeding*. North Carolina, USA: Humana Press.
- World Health Organisation. (2012). *Population-based approaches to childhood obesity prevention*. Geneva, Switzerland: World Health Organisation.

Chapter 2

A population approach to parenting support for childhood obesity: the Lifestyle Triple P multilevel system

This chapter consists entirely of the following paper to be submitted to *Obesity Reviews*:

Bartlett, J. A., & Sanders, M. R. (2016). *A population approach to parenting support for childhood obesity: the Lifestyle Triple P multilevel system.* Manuscript to be submitted for publication.

Abstract

Health authorities worldwide are calling for effective interventions to address childhood obesity. Parent-centered interventions have proven effective. However, parental recruitment into such programs remains a challenge. This article argues for a paradigm shift from a traditional targeted approach of intervening with already overweight or obese children, to a more inclusive population health model that blends a universal health promotion intervention with a targeted intervention for overweight children. The Lifestyle Triple P multilevel system is a suite of evidence-based parenting programs developed to prevent and treat childhood obesity. The approach adopts a population framework in order to increase intervention reach, and to combat obesity rates and associated health comorbidities on a population-level.

Keywords: population health; childhood obesity; Triple P; prevention; parenting; lifestyle intervention; prevention; children.

Introduction

Evidence-based parenting programs are a recommended pathway to prevent and treat childhood obesity (World Health Organisation [WHO], 2012). Despite their proven success, significant problems exist with parental recruitment and retention (Reinehr, 2013). There are very few parenting programs available that are prevention-focused, and no interventions to date have utilised a population health framework to shift obesity at a population level.

This report will present the argument for a population health model to prevent and treat obesity in children. The Lifestyle Triple P multilevel parenting and family support strategy will be outlined. This approach incorporates a suite of interventions, including: (1) a widespread media and communications campaign; (2) a light-touch, brief seminar series for all parents; and (3) an intensive intervention for parents of children who are already overweight or obese. The existing evidence base for components of this suite will be discussed, along with potential implementation challenges.

The rationale for a population approach to childhood obesity

Childhood obesity is considered one of the most serious health challenges in the developed world, with 170 million children less than 18 years of age overweight or obese (WHO, 2012). The highest prevalence rates are in the upper-middle-income countries, however there is also a rising trend in developing regions (Dehghan, Akhtar-Danesh, & Merchant, 2005; Kelishadi, 2007).

It is well established that excess body fat has serious health consequences. There is a positive correlation between body mass index (BMI) and cardiovascular disease, type 2 diabetes mellitus, and many cancers (Brown, Fujioka, Wilson & Woodworth, 2009; Guh, Zhang, Bansback, Amarsi, Birmingham & Anis, 2009). Obesity is associated with premature mortality (Prospective Studies Collaboration, 2009), reduced quality of life (Tsiros et al.,

2009; Williams, Wake, Hesketh, Maher, & Waters, 2005), and bullying and social isolation (Lobstein, Baur, & Uauy, 2004).

The public health burden of obesity is enormous. In 2008, the total cost of death and disability arising from obesity in Australia was estimated to be \$58.2 billion per year, representing a three-fold increase from 2005 (Crowle & Turner, 2010). This data suggests that obesity has progressed from being a problem of the individual to a worldwide challenge, which must be addressed at a population level.

There is general consensus that obesity initiatives should target parents (Golan, 2006; Lindsay, Sussner, Kim, & Gortmaker, 2006). Interventions that involve parents as agents for change are more effective than child-only interventions (Golan & Crow, 2004). Parents are in a prime position to influence the interrelationship between the child's genetics, behaviour and home environment. They serve as role models, are able to reinforce healthy (or unhealthy) behaviour patterns, and are the gatekeepers to accessible food within the home (Rozin, 1991). Parents who are active and eat well tend to have children who adopt similar habits (Cullen, Baranowski, Owens, Marsh, Rittenberry, & de Moor, 2003; Grimm, Harnack, & Story, 2004; van der Horst et al., 2006; Sallis, Alcaraz, McKenzie, Hovell, Kolody & Nader, 1992).

General parenting style has also been associated with child weight status (Gerards et al., 2012). A lax style of parenting in which few rules are enforced can adversely affect a child's lifestyle choices. Inadequate monitoring of the child's food intake can result in consumption of more energy-dense food and beverages (De Bourdeaudhuij et al., 2006), and decreased vegetable intake (Vereecken, Keukelier, & Maes, 2004). On the other hand, stringent control of dietary intake, where the child has little sense of self-regulation, can result in overeating (Johnson & Birch, 1994).

Although parenting interventions are an important tool for obesity management, there are significant barriers with recruitment and retention. Parents with overweight or obese children

have difficulty identifying their child as overweight, and as a result may not identify the relevance of lifestyle-specific programs. Parents with overweight children systematically underestimate their child's weight, with only 17% of parents correctly identifying their child as overweight (Carnell, Edwards, Croker, Boniface, & Wardle, 2005; Jones, Parkinson, Drewett, Hyland, Pearce, & Adamson, 2011).

It has been suggested that the level of importance parents place on the health risks associated with obesity is relatively low. One study found that parents ranked sun exposure as more serious to the child's health than obesity (Etelson, Brand, Patrick & Shirali, 2012). Obesity stigma may further hinder parents from self-selecting into interventions when weight is the target for change (Puhl & Heuer, 2010). Focus group research suggests that parents resist attendance for fear of creating an adverse emotional impact on their child (Reid, 2009). The length of existing obesity-specific parenting interventions may be another barrier to attendance, with a recent review identifying an average of 10 sessions per intervention (Gerards, Sleddens, Dagnelie, De Vries, & Kremers, 2011). Parents have identified program length as one of the major barriers to attendance (Nguyen et al., 2012). Other barriers to participation include unmet expectations, cost of attendance, and too much information provided during the intervention (Smith, Straker, McManus & Fenner, 2014).

A key platform in the management of the obesity epidemic should be a population health approach to parenting support. A population approach emphasises population-level behaviour change through a blend of universal and targeted interventions with differing levels of intervention intensity and breadth of reach. A universally accessible program that encourages the health of all children, whether at risk of obesity or not, is more likely to engage parents and enhance parental recruitment. It could potentially serve as a platform for referrals into more targeted programs for children with significant weight issues. A media campaign

designed to raise public awareness in relation to lifestyle choices and destigmatised parenting support would complement prevention and treatment initiatives.

A population-wide program that provides parents with strategies for dealing with general child behaviour *and* lifestyle-specific behaviour has the added potential of targeting other risk and protective factors beyond childhood obesity. Other modifiable factors could include enhancing parent mental health, parental confidence and competence, beliefs about child behaviour, problem solving and coping skills, communication skills and general parenting skills. Targeting multiple risk and protective factors within one program may be a more cost-effective approach to delivery of parenting support.

Lifestyle Triple P – parenting as a population health priority

The Triple P - Positive Parenting Program is one of the most widely used and extensively evaluated models of parenting support. It is one of the few evidence-based parenting programs designed specifically as a comprehensive population health model. The system incorporates five levels of intervention on a tiered continuum of increasing strength and narrowing reach for parents of children from birth to age 16. A summary of the wider Triple P system can be found in Sanders (2012).

Lifestyle Triple P is a variant of Triple P, developed specifically to prevent and treat childhood obesity through empowering parents with strategies and confidence to manage both lifestyle-specific and general child behaviour. An overview of the Lifestyle Triple P multilevel system is presented in Figure 4. There are currently three levels of the model which include: (1) a universal media campaign for all parents (Level 1); (2) a low-intensity, seminar series for all parents regardless of child weight status (Level 2); and (3) a targeted intensive program for children who are already overweight or obese (Level 5). Table 1 provides a description of each Lifestyle Triple P intervention.

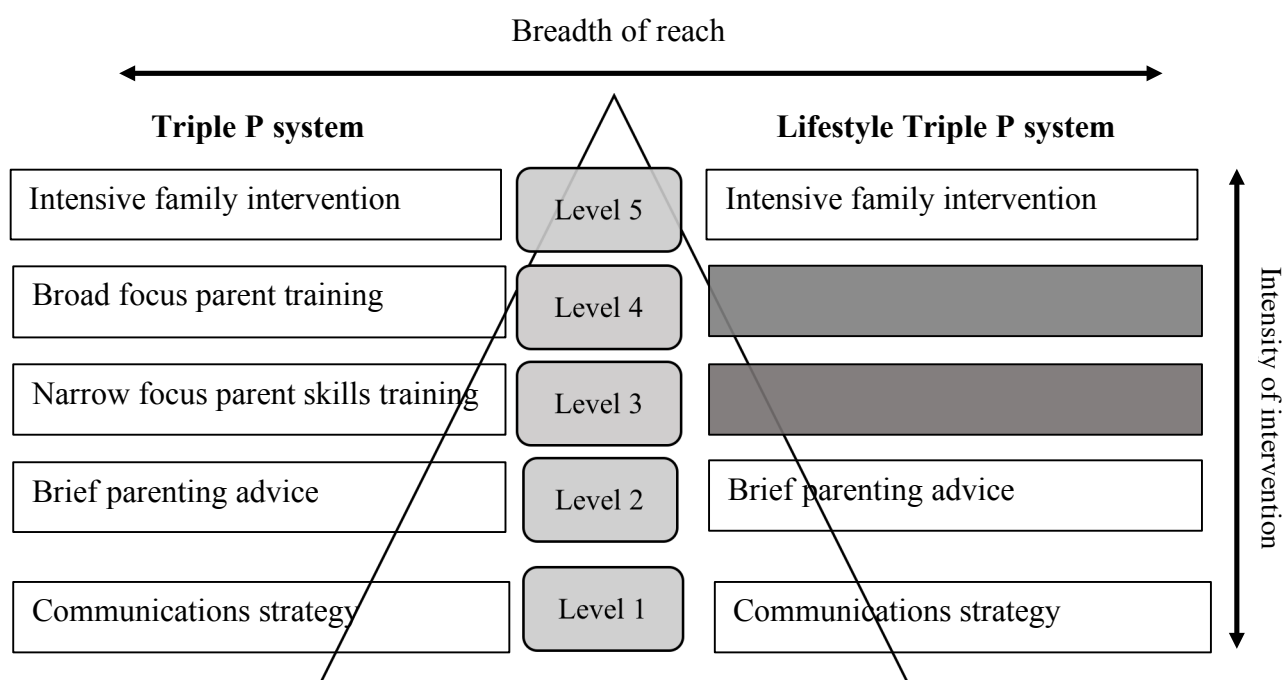


Figure 4. The Lifestyle Triple P multilevel system of graded reach and intensity of parenting and family support services for childhood obesity, alongside the broader Triple P multilevel system. Source: adapted from Sanders, 2012

The Lifestyle Triple P evidence base

The Triple P system has a strong evidence base (Sanders, Kirby, Tellegen, & Day, 2014), and is one of the only parenting interventions to demonstrate reductions in population level indices of child maltreatment and behavioural problems. The first evaluation of the Triple P system at a population level targeted parents of all children aged 4 – 7 years in 20 geographic catchment areas in Australia (Sanders et al., 2008). Each catchment area was randomly allocated to either receiving the Triple P system or care as usual control. Parents in the Triple P communities had access to the suite of interventions, including media campaign, brief parenting seminars, and intensive programs (either individual or group-based). Structured computer-assisted telephone interviews were used to evaluate population level outcomes. Following the 2-year intervention period, the Triple P communities showed a significantly

greater reduction in child behavioural and emotional problems, dysfunctional parenting, and parental stress and depression.

Further support for the use of the Triple P system to produce population level effects comes from research conducted in 18 counties in South Carolina (US; Prinz, Sanders, Shapiro, Whitaker & Lutzker, 2009). Following the intervention, the Triple P counties had lower rates of founded cases of child maltreatment, hospitalisations, injuries, and out-of-home placements due to maltreatment. These findings support the use of the Triple P system to produce population-level change, and provide promise for the potential value of a population approach to lifestyle parenting support.

The Lifestyle Triple P system has not been evaluated at a population level. However, two published randomised controlled trials, and a number of pilot studies have evaluated the efficacy of the intensive Level 5 intervention (Group Lifestyle Triple P). The first evaluation of the Level 2 intervention (Lifestyle Triple P Seminar Series) will be presented in Chapter 3 of the current thesis. The Lifestyle Triple P media and communication campaign has not yet been evaluated.

West, Sanders, Cleghorn and Davies (2010) evaluated the intensive program with parents of overweight or obese children aged 4–11 years in Brisbane, Australia. Parents were randomly allocated to the intervention or waitlist control groups. Assessment occurred at baseline, post-intervention, and 12-months follow-up. Results showed a significant reduction in child BMI *z*-scores following the intervention, with a mean BMI *z*-score reduction of 0.11 ($d = 0.13$, 95% CI [0.06, 0.21]). Additional improvements for BMI *z*-score were found at 12-months follow-up (mean BMI *z*-score reduction of 0.19, $d = 0.43$, 95% CI [0.18, 0.67]). A significant decrease was also observed for child weight-related problem behaviour and dysfunctional parenting styles, and parental confidence increased. These intervention effects

were medium-to-large, and were maintained at 12-months follow-up. These results support the efficacy of this intervention as a treatment tool for childhood obesity.

Two pilot trials of Group Lifestyle Triple P were conducted in community health settings in Western Australia in 2009 and 2011 (Child & Adolescent Community Health Service, 2011a, 2011b). The first trial included 50 parents of overweight and obese children aged 5 - 10 years. Following the intervention, there was a significant reduction in BMI *z*-scores (mean BMI *z*-score reduction of 0.13), and child emotional difficulties. Child lifestyle behaviour and weekend physical activity improved, and weight-related problems and total energy intake (kilojoules) significantly decreased. Parent outcomes included a reduction in dysfunctional parenting style and stress levels, and an increase in parental confidence. Intervention effects were sustained at 6-months follow-up for parenting style and confidence, weight-related problem behaviour, and child emotional difficulties. Although the BMI *z*-score reduction was not maintained at 6-months post-intervention, the mean score remained lower than the baseline score, with a mean BMI *z*-score reduction of 0.08 at 6-months.

The second pilot trial evaluated Group Lifestyle Triple P with 27 families at pre-intervention and post-intervention. Following the intervention, a significant reduction in problematic lifestyle behaviour, and emotional and behavioural difficulties was found. Parents also reported improvements on depression levels, dysfunctional and lax parenting styles, and parental confidence. There was a significant reduction in BMI *z*-scores (mean BMI *z*-score reduction of 0.20). Although both pilot trials had a small sample size and no control group comparison, the findings are promising, and support the results from larger RCTs advocating the effectiveness of the program.

A further promising finding for Group Lifestyle Triple P comes from research in the Netherlands (Gerards et al., 2015). Eighty-six parents of overweight and obese children aged 4 - 8 years were randomly allocated to the intervention or control condition. Positive short-

term intervention effects were found for children's soft-drink consumption, parental responsibility regarding physical activity, encouragement to eat, psychological control, and parental confidence and satisfaction with parenting. At 12-months post-intervention, effects were found on sedentary behaviour, time spent playing outside, parental monitoring of food intake, and responsibility regarding nutrition. No significant intervention effects were found on BMI *z*-score. This finding may be due to the degree of child adiposity in the sample included. Children had a mean baseline BMI *z*-score of 1.85, with only 63% classified as obese. Conversely, in the Australian trial children had a mean baseline BMI *z*-score of 2.11 (i.e., more overweight). Therefore, it may be that there was insufficient power to detect a statistically significant change in BMI *z*-score.

Another explanation for the lack of findings on child BMI *z*-score in the Netherlands trial could be due to baseline differences in parent weight status. Parents in the intervention group had a higher BMI than the control parents. It may be that parents with weight issues may find it more difficult to make lifestyle changes in their family. It is recommended that future research control for differences in parental weight status at baseline to see if significant BMI *z*-scores result. Research studies exploring moderators and mediators of intervention change are important in order to identify at-risk groups who may need further attention.

The first trial of the Lifestyle Triple P Seminar Series was conducted in Brisbane, Australia, and is described in Chapter 3 of this thesis (Bartlett, Sanders, & Leong, 2016). One hundred and sixty parents were randomly allocated to either the intervention or control condition, and were assessed at pre-intervention, post-intervention, and 6- and 12-months follow-up. Results revealed significant improvements on lifestyle-specific and general parental confidence, parenting styles, and child lifestyle problem behaviour at 12-months follow-up. Parents in the control condition showed an increase in the total time the child spent watching television, with no such worsening of screen time in the intervention

condition. Child BMI *z*-scores and weight *z*-scores showed a trend in the intended direction with a reduction in the intervention condition, however this difference was not statistically significant. Results support the efficacy of the Lifestyle Triple P Seminar Series in shifting lifestyle-related child and parent outcomes, and its role as a universal parenting intervention designed to increase healthy home environments for all children regardless of weight status.

How a population health approach to parenting works

It is important to consider the broader ecological context of parenting and lifestyle change when designing interventions to shift population-level outcomes. Figure 6 illustrates the range of variables that can be targeted to facilitate engagement by particular parent groups.

Intervention variables refers to features of an intervention that can be adapted or tailored to ensure that interventions are culturally relevant, universally accessible, low or no cost to parents, and use messages that are relevant and meaningful to parents.

Social influence factors refer to how a parent attends a program and who attends the intervention with the parent. It involves activating the social environment in which the parent resides in order to support sustained lifestyle change at a family level. Parents may encounter difficulty when implementing parenting strategies through a lack of partner or extended family support. Features of the social context may include who is invited to attend the intervention, such as partners, kinship carers, friends, or work colleagues. Activation of the social contagion through parent-to-parent social conversations can increase demand for programs and help destigmatise attendance. The goal is to create a “pull demand” from parents for evidence-based parenting programs so that participation is viewed as advantageous for their family.

Cognitive variables should also be targeted to increase parental awareness of the usefulness and personal relevance of the program to their family. Addressing parental cognitions around the benefits of participation (“this will help my child”), and challenging

unhelpful or maladaptive attributions (“there is nothing I can do to change my child or parenting”) is key to facilitating parental engagement.

By addressing *motivational factors* we can ensure that parental needs and preferences are met. Parents with competing demands (e.g., chronic stress or significant time pressures) may be unlikely to participate in available interventions. These barriers to attendance may be addressed through tailoring of intervention delivery format (e.g., online or in-person) or providing incentives for participation. Some organisations have provided free food or beverages, childcare facilities, transportation assistance, or financial incentives (such as entry into a prize draw) to increase the intrinsic value of interventions to parents.

Parental concern for the child’s future is another factor that should be addressed. If a parent perceives their child as having some form of pre-existing vulnerability (e.g., preterm infant, disability, health concern, weight issue, experience of relationship breakdown) they may be more likely to attend a parenting intervention, compared to a parent who perceives their child as not needing any particular help. A key factor to enabling attendance is helping parents understand the importance and potential positive change that can result from attending such interventions. Encouraging healthy lifestyle habits for the child both now and in the future may be a powerful motivator for program attendance.

Population-level outcome measurement

In order to document population-level change there is a need for the use of reliable and valid measurement of population-level effects. From a policy-level perspective, this is important in order to determine whether investment in specific programs have achieved the desired outcomes. A metric that is population-based and can be conducted within the school context to serve to identify potential target families and make appropriate referrals would be ideal.

Universally accessible

The World Health Organisation (2012) recommends that global strategies for population-based obesity preventions should focus on ensuring all children have a healthy start in life. An all-inclusive population health approach can be achieved through shifting the focus from management of weight alone to promoting healthy living for all families in the community. To be effective, a whole-population approach must emphasise the universal relevance of parenting programs for healthy living to ensure parental reach. This can be achieved through a media campaign that avoids creating the stigma associated with seeking parenting support, and places emphasis on living a healthy lifestyle for all family members.

Culturally appropriate

To achieve population-level impact, context-specific considerations are needed to ensure the intervention suits different cultures and communities, such as awareness of different food items available and accessible to families, healthy eating guidelines according to that particular country, and cultural traditions associated with food. These factors may make it difficult to readily apply existing interventions to different cultural and ethnic groups. Triple P has been shown to work with families from diverse cultures. Several culturally specific studies have been conducted, for example with low-resource settings in Panama (Mejia, Calam, & Sanders, 2015), with Indonesian parents (Sumargi, Sofronoff, & Morawska, 2015), and with Australian Indigenous families (Turner, Richards, & Sanders, 2007). Consultation with local agencies and focus group research allows culturally appropriate adaptations. This may include changes to session length or group duration, degree of reliance on workbook materials, and adapting content to match local lifestyle habits and nutrition or activity guidelines.

Minimally sufficient and cost-effective approach

The Triple P model avoids a one-size-fits-all approach by tailoring the intensity of the intervention to suit the needs of the parents and child. The principle of ‘minimal sufficiency’ in population health refers to the selection of interventions aimed at achieving a meaningful clinical outcome in the most cost-effective and time-efficient manner (Sanders, 2012).

Offering the brief seminar universally to all parents, and the intensive intervention selectively to parents of overweight or obese children ensures such a minimally sufficient approach. A cost-effective and efficient approach that leads to sustainable results for all children is a key ingredient for a population health model.

Training and dissemination capacity

Practitioners from different disciplines can be trained and accredited in Triple P. This ensures that the delivery of the program is robust enough to be successfully implemented in diverse settings and communities. The multidisciplinary nature of the program involves the use of the existing workforce, which may allow policy makers to give due consideration to cost-effectiveness. Once a program is in place, ongoing implementation guidelines are necessary to ensure intervention fidelity. Such guidelines for Triple P already exist (Brown & McWilliam, 2012), and enable ongoing assessment by organisations responsible for program delivery.

Conclusion

There is evidence that parenting programs are an effective approach to treating childhood obesity. One of the key barriers to success is parental participation and engagement. The Lifestyle Triple P multilevel system aims to address these concerns, and applies a population health framework to childhood obesity prevention and intervention efforts. The Triple P model has shown population-level changes in child behaviour and maltreatment. Research supports the efficacy of the Level 2 Lifestyle Triple P Seminar Series and Level 5 Group

Lifestyle Triple P. Future research should be conducted to establish the population-level effects of the entire Lifestyle Triple P system delivered at a community level. Evaluation trials of the lifestyle media and communication campaign are also needed. The ongoing increase in obesity rates would suggest that a population approach may be a major part of the ultimate solution.

References

- Birch, L. L., & Ventura, A. K. (2009). Preventing childhood obesity: what works? *International Journal of Obesity*, 33, s74-81. doi: 10.1038/ijo.2009.22
- Brown, J., & McWilliam, J. (2012, October). *An implementation framework for the Triple P – Positive Parenting Program*. Paper presented at the biennial Australian Implementation Conference, Melbourne, VIC.
- Brown, W. V., Fujioka, K., Wilson, P. W., & Woodworth, K. A. (2009). Obesity: why be concerned? *American Journal of Medicine*, 122, S4-S11. doi: 10.1016/j.amjmed.2009.01.002
- Carnell, S., Edwards, C., Croker, H., Boniface, D., & Wardle, J. (2005). Parental perceptions of overweight in 3 – 5 year olds. *International Journal of Obesity*, 29, 353-355. doi: 10.1038/sj.ijo.0802889
- Child and Adolescent Community Health Service. (2011a). *Lifestyle Triple P: Full Report of the 2009 Western Australian Community Health Pilot*. Unpublished report. Western Australia: Department of Health Western Australia.
- Child and Adolescent Community Health Service. (2011b). *Lifestyle Triple P: Key findings of the 2010 Western Australia community health pilot*. Unpublished report. Western Australia: Department of Health Western Australia.
- Crowle, J. & Turner, E. (2010). *Childhood obesity: An economic perspective*. Productivity Commission Staff Working Paper, Melbourne, VIC.
- Cullen, K. W., Baranowski, T., Owens, E., Marsh, T., Rittenberry, L., & de Moor, C. (2003). Availability, accessibility, and preferences for fruit, 100% fruit juice, and vegetables influence children's dietary behavior. *Health Education & Behaviour*, 30, 615-626.
- De Bourdeaudhuij, I., Yngve, A., te Velde, S. J., Klepp, K. I., Rasmussen, M., Thorsdottir, I., Wolf, A., & Brug, J. (2006). Personal, social and environmental correlates of vegetable

- intake in normal weight and overweight 9- to 13-year old boys. *International Journal of Behavioral Nutrition and Physical Activity*, 3, 37-46. doi: 10.1186/2F1479-5868-3-37
- Dehgran, M., Akhtar-Danesh, N., & Merchant, A. T. (2005). Childhood obesity, prevalence and prevention. *Nutrition Journal*, 4, 24-32. doi: 10.1186/2F1475-2891-4-24
- Etelson, D., Brand, D. A., Patrick, P. A., & Shirali, A. (2012). Childhood obesity: Do parents recognize this health risk? *Obesity Research*, 11, 1362-1368. doi: 10.1038/oby.2003.184
- Gerards, S. M. P., Dagnelie, P. C., Jansen, M. W. J., de Vries N. K., & Kremers, S. P. J. (2012). Barriers to successful recruitment of parents of overweight children for an obesity prevention intervention: a qualitative study among youth health care professionals. *BMC Family Practice*, 13, 1-10. doi: 10.1186/1471-2296-13-37.
- Gerards, S. M. P. L., Dagnelie, P. C., Gubbels, J. S., Buuren, S. V., Hamers, F. J. M., Jansen, M. W. J., ... Kremers S. P. J. (2015). The effectiveness of Lifestyle Triple P in the Netherlands: A randomised controlled trial. *PLOS One*, 10, 1-18. doi: 10.1371/journal.pone.0122240
- Gerards, S. M., Sleddens, E. F. C., Dagnelie, P. C., De Vries, N. K., & Kremers, S. P. J. (2011). Interventions addressing general parenting to prevent or treat childhood obesity. *International Journal of Pediatric Obesity*, 6, e28-e45. doi: 10.3109/17477166.2011.575147
- Golan, M. (2006). Parents as agents of change in childhood obesity – from research to practice. *International Journal of Pediatric Obesity*, 1, 66-76.
- Golan, M., & Crow, S. (2004). Targeting parents exclusively in the treatment of childhood obesity: Long-term results. *Obesity Research*, 12, 357-361. doi: 10.1038/oby.2004.45
- Grimm, C. G., Harnack, L., & Story, M. (2004). Factors associated with soft drink consumption in school-aged children. *Journal of the American Dietetic Association*, 104, 1244-1249. doi: 10.1016/j.jada.2004.05.206

- Guh, D. P., Zhang, W., Bansback, N., Amarsi, Z., Birmingham, C.L., & Anis, A. H. (2009). The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. *BMC Public Health*, 9, 88. doi: 10.1186/1471-2458-9-88
- Johnson, S. L., & Birch, L. L. (1994). Parent's and children's adiposity and eating style. *Pediatrics*, 94, 653-661.
- Jones, A. R., Parkinson, K. N., Drewett, R. F., Hyland, R. M., Pearce, M. S., & Adamson, A. J. (2011). Parental perceptions of weight status in children: The Gateshead Millennium Study. *International Journal of Obesity*, 35, 953-962. doi: 10.1038/ijo.2011.106
- Kelishadi, R. (2007). Childhood overweight, obesity, and the metabolic syndrome in developing countries. *Epidemiology Reviews*, 29, 62-76. doi: 10.1093/epirev/mxm003
- Lindsay, A. C., Sussner, K. M., Kim, J., & Gortmaker, S. L. (2006). The role of parents in preventing childhood obesity. *The Future of Children*, 16, 169-186.
- Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: a crisis in public health. *Obesity Reviews*, 5, 4-104. doi: 10.1111/j.1467-789X.2004.00133.x
- Mejia, A., Calam, R., & Sanders, M. R. (2015). A pilot randomized controlled trial of a brief parenting intervention in low-resource settings in Panama. *Prevention Science*, 16, 707-717. doi: 10.1007/s11121-015-0551-1
- Nguyen, B., McGregor, K. A., O'Connor, J., Shrewsbury, V. A., Lee, A., Steinbeck, K. S., Hill, A. J., Shah, S., Kohn, M. R. & Baur, L. A. (2012). Recruitment challenges and recommendations for adolescent obesity trials. *Journal of Pediatrics and Child Health*, 48, 38-43. doi: 10.1111/j.1440-1754.2011.02183.x
- Prinz, R. J., Sanders, M. R., Shapiro, C. J., Whitaker, D. J., & Lutzker, J. R. (2009). Population-based prevention of child maltreatment: The U.S. Triple P system population trial. *Prevention Science*, 10, 1-12. doi: 10.1007/2Fs11121-009-0123-3

- Puhl, R. M., & Heuer, C. A. (2010). Obesity stigma: important considerations for public health. *American Journal of Public Health, 100*, 1019-1128. doi: 10.2105/2FAJPH.2009.159491
- Reid, M. (2009). *Debrief of a study to identify and explore parental, young people's and health professionals' attitudes, awareness and knowledge of child healthy weight*. Edinburgh: NHS Health Scotland.
- Reinehr, T. (2013). Lifestyle intervention in childhood obesity: Changes and challenges. *Nature Reviews Endocrinology, 9*, 607-614. doi: 10.1038/nrendo.2013.149
- Rozin, P. (1991). Family resemblance in food and other domains: the family paradox and the role of parental congruence. *Appetite, 16*, 93-102.
- Sallis, J. F., Alcaraz, J. E., McKenzie, T. L., Hovell, M. F., Kolody, B., & Nader, P. R. (1992). Parental behavior in relation to physical activity and fitness in 9-year-old children. *American Journal of Diseases of Children, 146*, 1383-1388. doi: 10.1001/archpedi.1992.02160230141035
- Sanders, M. R. (2012). Development, evaluation, and multinational dissemination of the Triple P – Positive Parenting Program. *Annual Review of Clinical Psychology, 8*, 345-379. doi: 10.1146/annurev-clinpsy-032511-143104
- Sanders, M. R., Kirby, J. N., Tellegen, C. L., & Day, J. J. (2014). The Triple P – Positive Parenting Program: A systematic review and meta-analysis of a multi-level system of parenting support. *Clinical Psychology Review, 34*, 337-357. doi: 10.1016/j.cpr.2014.04.003
- Sanders, M. R. & Morawska, A. (*in press*). Towards an evidence-based population approach to parenting in the early years. In Leach, P. J. (Eds.), *Innovative research in infant wellbeing: best practices and policies for the first 1001 critical days*. London, UK: Routledge.

- Sanders, M. R., Ralph, A., Sofronoff, K., Gardiner, P., Thompson, R., Dwyer, S., & Bidwell, K. (2008). Every family: A population approach to reducing behavioural and emotional problems in children making the transition to school. *Journal of Primary Prevention*, 29, 197–222. doi: 10.1007/s10935-008-0139-7
- Smith, K. L., Straker, L. M., McManus, A., & Fenner, A. A. (2014). Barriers and enablers for participation in healthy lifestyle programs by adolescents who are overweight: a qualitative study of the opinions of adolescents, their parents and community stakeholders. *BMC Pediatrics*, 14, 1-14. doi: 10.1186/1471-2431-14-53
- Sumargi, A., Sofronoff, K., & Morawska, A. (2015). A randomized-controlled trial of the Triple P – Positive Parenting Program Seminar Series with Indonesian parents. *Child Psychiatry & Human Development*, 46, 749-761. doi: 10.1007/s10578-014-0517-8
- Tsiros, M. D., Olds, T., Buckley, J. D., Grimshaw, P., Brennan, L., Walkley, J., Hills, A. P., Howe, A., & Coates, A. M. (2009). Health-related quality of life in obese children and adolescents. *International Journal of Obesity*, 33, 387-400. doi: 10.1038/ijo.2009.42
- Turner, K. M. T., Richards, M., & Sanders, M. R. (2007). Randomised clinical trial of a group parent education program for Australian indigenous families. *Journal of Paediatrics and Child Health*, 43, 429–437. doi: 10.1111/j.1440-1754.2007.01053.x
- van der Horst, K., Oenema, A., Ferreira, I., Wendel-Vos, Q., Giskes, K., van Lenthe, F., & Brug, J. (2007). A systematic review of environmental correlates of obesity-related dietary behaviours in youth. *Health Education Research*, 22, 203-226. doi: 10.1093/her/cyl069
- Vereecken, C. A., Keukelier, E., & Maes, L. (2004). Influence of mother's educational level on food parenting practices and food habits of young children. *Appetite*, 43, 93-103. doi: 10.1016/j.appet.2004.04.002
- West, F. & Sanders, M. R. (2010). *Facilitator's manual for Group Lifestyle Triple P*. Brisbane, Australia: Triple P International.

- West, F., Sanders, M. R., Cleghorn, G.J., & Davies, P. S. W. (2010). Randomised clinical trial of a family-based lifestyle intervention for childhood obesity involving parents as the exclusive agents of change. *Behaviour Research and Therapy*, 48, 1170-1179. doi: 10.1016/j.brat.2010.08.008
- Williams, J., Wake, M., Hesketh, K., Maher, E., & Waters, E. (2005). Health-related quality of life of overweight and obese children. *Journal of American Medical Association*, 293, 70-76. doi: 10.1001/jama.293.1.70
- World Health Organisation. (2012). *Population-based approaches to childhood obesity prevention*. Geneva, Switzerland: World Health Organisation.

Table 1. The Lifestyle Triple P multilevel system of parenting and family support for childhood obesity.

Program	Intensity	Target population	Duration	Content
Group Lifestyle Triple P (Level 5)	High intensity	Parents of overweight or obese children.	14-session group program (including 10 group sessions and 4 telephone consultations) delivered over 17 weeks.	Content includes: understanding nutrition, understanding physical activity, using rewards and modifying recipes, limiting sedentary activity and playing active games, reading food labels, managing problem behaviour and planning ahead.
Lifestyle Triple P Seminar Series (Level 2)	Low intensity	Parents of children from all weight status.	3-session seminar series delivered over 3 weeks.	Aimed at improving practical parenting skills to encourage healthy living. Topics include: positive parenting, fussy eating, reading food labels, modifying recipes, and nutrition knowledge and physical activity guidelines.
Stay Positive and Healthy Media and Communication Strategy (Level 1)	Very low intensity	All parents and community members interested in healthy lifestyle information.	-	Widespread population level campaign aimed at improving awareness of healthy options and at normalizing parenting support. The campaign may involve a range of activities including school newsletters, newspaper advertisements, radio spots and a specially developed website.

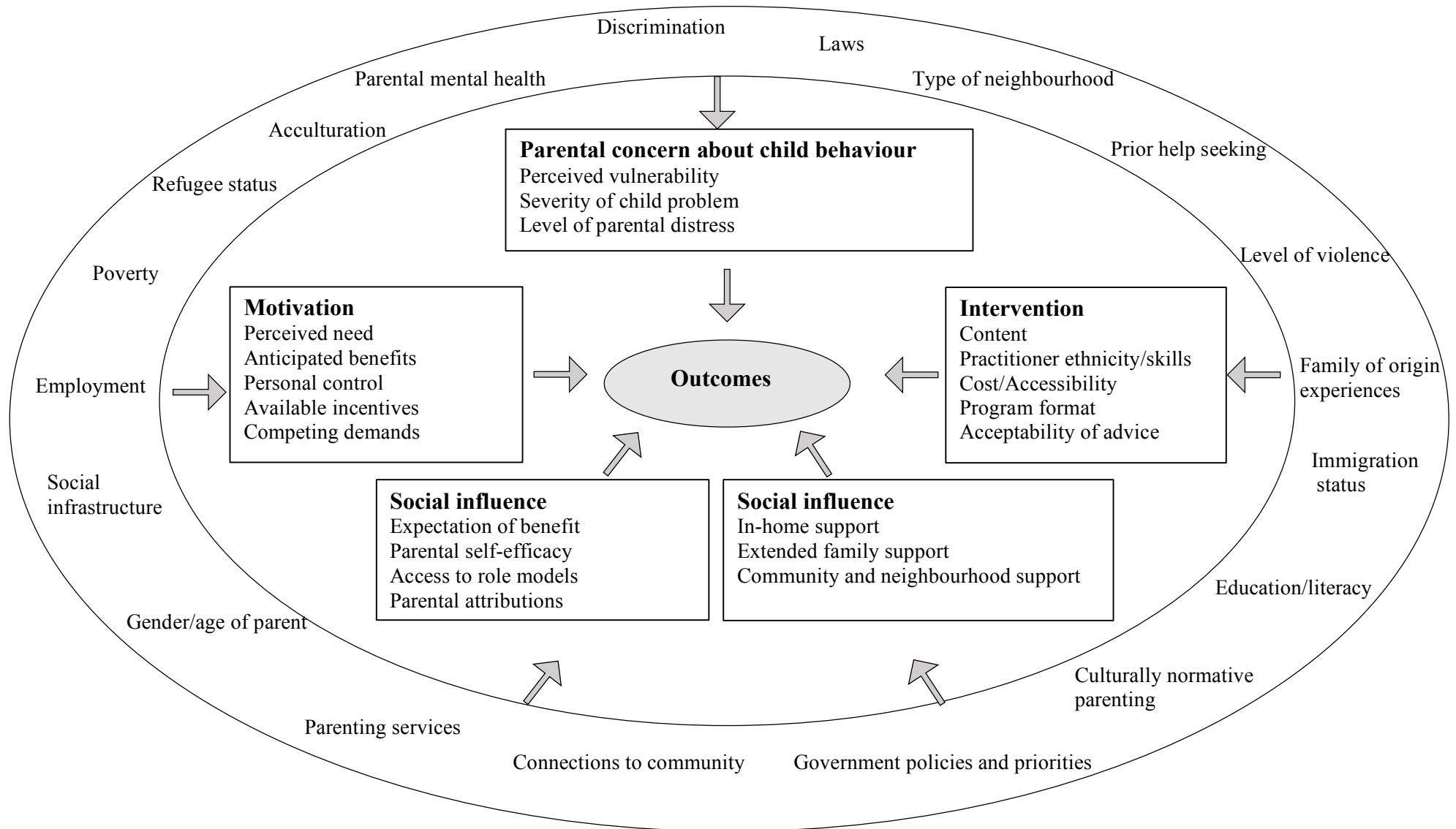


Figure 6. Illustration of the range of variables that can be targeted to facilitate engagement by particular parent groups. Source: reproduced from Sanders and Morawska (*in press*).

Chapter 3

Randomised controlled trial of Triple P for healthy living: The Lifestyle Triple P Seminar Series

This chapter consists entirely of the following paper to be submitted to *Journal of Child Psychology and Psychiatry*:

Bartlett, J. A., Sanders, M. R., & Leong, G. M. (2016). *Randomised controlled trial of Triple P for healthy living: The Lifestyle Triple P Seminar Series*. Manuscript submitted for publication.

Abstract

Background: Parents play a key role in establishing a healthy home environment. Most existing parent-centered interventions for childhood obesity have a focus on child weight, are long in duration, and have poor attendance rates. This study examined the efficacy of a new universal brief parenting intervention (Lifestyle Triple P Seminar Series) in improving general and lifestyle-specific parent and child outcomes.

Methods: A total of 160 parents with children aged 3 to 10 years were randomly assigned to the intervention or control condition. The intervention consisted of three 2-hour group sessions delivered by a trained, accredited practitioner. Parenting styles, parental self-efficacy, and child lifestyle-specific and general behaviour were assessed via parent self-report. Physical activity levels were measured objectively using accelerometers. Dietary intake was evaluated via a food diary. Child anthropometry, including body mass index and waist circumference, was obtained. Outcome assessment occurred at pre-intervention, post-intervention, and 6- and 12-months. The trial was registered with the Australia New Zealand Trials Registry: ACTRN12612000865819, www.anzctr.org.au.

Results: Intention-to-treat analyses indicated a reduction in overall ineffective parenting, laxness, overreactivity and verbosity parenting styles after the intervention. Lifestyle-specific and general parental confidence significantly improved. Child lifestyle problem behaviour reduced following the intervention, however no changes were observed in general child behaviour. All intervention effects were maintained at 12-months follow-up. No changes were found on child body size, nutrition, or physical activity. Overall parenting, laxness, and verbosity intervention effects showed evidence of reliable and clinical change.

Conclusions: A brief, group-based parenting program with a focus on encouraging a healthy lifestyle for all families may provide health authorities with a cost-effective model for improving health behaviours at a population level.

Keywords: childhood obesity; prevention; Triple P; lifestyle intervention; family-based; parenting; brief intervention; public health; randomised controlled trial.

Background

Childhood obesity presents a major public health dilemma. The alarming rise in the prevalence of obesity in childhood has created concern amongst government agencies and policy makers. It is well accepted that obesity leads to physical and psychological comorbidity, and is a contributing factor to premature death (Lobstein, Baur, & Uauy, 2004). Estimates of the public health costs are staggering (Crowle & Turner, 2010).

Health habits in childhood lead to lifestyle patterns in the future (Mamun, Lawlor, O’Callaghan, Williams, & Naiman, 2005). The benefits of an active child with a healthy nutritional intake include an enhanced health status, better academic performance, and improved social and emotional outcomes (Bauman, 2004; Rampersaud, Pereira, Girard, Adams & Metz, 2005). Intervention at a young age before lifestyle habits have become established is likely to be more effective and sustainable approach than interventions during late childhood or adolescence (Birch & Ventura, 2009).

Reactive management of childhood obesity has often been the approach in the past (World Health Organisation, 2012). Existing parent-centered interventions for obesity are primarily delivered to children who are already overweight or obese, suffer recruitment difficulties, and have little or no emphasis on improving parenting skills (Nguyen et al., 2012; Lindsay, Sussner, Kim & Gortmaker, 2006). These programs are also long in duration, ranging from 9 weeks to 6 months (Gerards, Sleddens, Dagnelie, De Vries, & Kremers, 2011). No randomised controlled trial to date has demonstrated that a short-term intervention produces long-term success at 12-months follow-up (Reinehr, 2013). Evidence for maintenance of treatment change at 12-months following the intervention is important given the long-term health benefits associated with such changes.

The aim of this research is to evaluate the effectiveness of a relatively brief, universal lifestyle prevention program for parents of children aged 3 to 10 years. The Lifestyle Triple P

Seminar Series was delivered over three, 2-hour sessions and addressed physical activity, nutrition, and parenting. The aim of this program was to improve child and parent outcomes at 12-months follow-up. Primary outcomes were measures of parenting style, child behaviour in both general and lifestyle-specific domains, and child physical activity and nutrition. Secondary outcomes were parent BMI and measures of child adiposity, including body mass index and waist circumference.

Methods

Design

The study was a randomised controlled trial with a 2 (condition: intervention versus control) by 4 (time: pre-intervention [Time 1], post-intervention [Time 2], 6-months [Time 3], and 12-months [Time 4] follow-up) design. The CONSORT guidelines were utilised.

Randomisation was via computer-generated random number sequence by a contact independent of allocation consignment with no clinical involvement in the trial, using a random block design (block size of 10) in order in which families completed pre-intervention assessment. The project coordinator was informed of allocation, and participants were sent a notification letter.

Participants

Participants were recruited between January 2012 and May 2015 through community outreach in mass media, online forums, and schools and childcare centres around Brisbane, Australia. All participants completed a telephone interview to assess eligibility and discuss study requirements. Parents were eligible if they had a child aged 3 to 10 years. Exclusion criteria included: (1) the child had a severe developmental delay, chronic illness or disability; (2) the child was currently consulting another professional for weight management or behavioural and/or emotional problems; or (3) the child was taking medication that affected growth or weight.

G*Power software was used to calculate statistical power analyses. To detect a medium effect size ($d = 0.50$), a minimum of 153 parents were needed to give at least 80% power. Of 224 parents who completed the telephone screening, 180 (91%) met the inclusion criteria. Forty-four parents (20%) declined participation, with the major reason being that parents wanted a program without a health-focus. Of those eligible, 160 (83%) were randomised to either the intervention or control condition ($n = 80$ in each). The flow of participants through the study is shown in Figure 7.

Participants were 160 parents, with an average age of 39 years ($SD = 5.01$). They were predominately mothers (92%), with 59% overweight or obese and 40% healthy weight. Eight percent of parents were fathers. The average age of children (91 females, 89 males) was 6 years ($SD = 1.91$), with 63% within the healthy weight range and 35% overweight or obese (Cole, Bellizzi, Flegal, & Dietz, 2000). Seventy-five percent of the parents were married, with an average of 2.17 ($SD = 0.86$) children in each family. Most of the parents (76%) were born in Australia or New Zealand. The majority of primary parents had completed a university degree with undergraduate (34%) or postgraduate qualifications (35%). Seventy-three percent of the parents were employed, working an average of 27.90 hours a week ($SD = 13.32$). Most parents were able to meet household expenses (82%). The majority of parents (89%) had not participated in any lifestyle intervention or parenting program previously. Sample demographic characteristics are shown in Table 2.

Procedure

This study was conducted at The University of Queensland, Brisbane, Australia from 2014 to 2016. Interventions were conducted at two university sites (Ipswich and St Lucia). Ethical approval was granted by The University of Queensland Behavioural and Social Sciences Ethical Review Committee (#2012000219), and registered on the Australian New Zealand Clinical Trials Registry (ACTRN12612000865819).

Interested parents were screened for eligibility and informed about study requirements via telephone. Baseline assessment was then completed, and included: (1) self-report questionnaires (available online or printed format); (2) a 3-day food diary of child food intake; (3) the child wearing an accelerometer for 7 days; and (4) attendance at two assessment visits to assess anthropometric measurements and distribute assessment materials.

The first assessment visit was approximately 30 minutes; the second visit was around 20 minutes. The first visit involved a 15-minute training video detailing instructions for accurately positioning the accelerometer and completing the food diary. Child and parent anthropometric measurements were also taken. The second visit occurred approximately 8 days later, and involved returning the monitoring materials.

Once 10 eligible families had completed baseline assessment, parents were randomly allocated to intervention or control conditions. Intervention participants were offered access to the next available parenting group, and repeated the assessment process at 2-, 6- and 12-months. Parents assigned to the control condition repeated assessments at 2-, 6- and 12-months post-enrolment. These parents were offered the program following completion of all assessment, and received no materials or intervention prior.

Intervention

The Lifestyle Triple P Seminar Series is a 3-session parenting program designed to help parents raise healthy children by providing information and practical strategies for positive parenting, healthy eating, and physical activity. The intervention consisted of three 2-hour group sessions conducted weekly. Partners (if applicable) were invited to attend. Children did not attend sessions; however free childcare was available to increase parental attendance.

The first seminar focused on positive parenting strategies for a healthy home environment. This seminar introduced parents to the five core principles of positive parenting in the context of promoting a healthy lifestyle. The second seminar introduced parents to nutrition strategies,

such as establishing healthy eating routines, dealing with fussy eating, and reading food labels to select healthy foods. The third seminar outlined ways for parents to promote physical activity through reducing sedentary activity and screen-based behaviour, increasing incidental activities and promoting participation in organised physical activities.

Every family received tip sheets to reinforce session content. If necessary, families were offered make-up sessions for missed seminars. Group sizes ranged from three to fifteen families ($M = 6.00$, $SD = 3.56$).

Protocol adherence

Triple P has an internationally coordinated system of training and accreditation designed to promote treatment fidelity. All sessions were delivered by a practitioner trained and accredited in Lifestyle Triple P, who was a provisionally registered psychologist completing postgraduate training in clinical psychology. Structured session checklists were completed following each session, and an independent observer assessed video-recordings of 60% of sessions to assess content covered.

Outcome measures

Demographic characteristics

The *Family Background Questionnaire* (FBQ; West & Sanders, 2010) was used to collect participant demographic information.

Parent adjustment

The *Depression Anxiety and Stress Scale-21* (DASS-21; Lovibond & Lovibond, 1995) assessed baseline symptoms of parental psychological distress, including depression, anxiety and stress. The Depression, Anxiety and Stress subscales demonstrated acceptable to excellent internal consistencies ($\alpha = .90$, $\alpha = .73$, and $\alpha = .87$, respectively).

Child behaviour

The *Lifestyle Behaviour Checklist* (LBC; West & Sanders, 2009) is a 25-item measure assessing child lifestyle-specific problem behaviour (e.g., eating unhealthy snacks, too much screen time, or demanding food). Parents rate the extent to which they are experiencing each behaviour, with higher scores indicating greater problems. The LBC Problem scale demonstrated high internal consistency ($\alpha = .88$).

The *Child Adjustment and Parent Efficacy* (CAPES; Morawska, Sanders, Haslam, Filus & Fletcher, 2014) is a 30-item measure, which assesses child behavioural and emotional adjustment. Parents rate the extent to which each behaviour applies to their child, with higher scores indicate higher levels of problem behaviour. The Intensity, Behavioural and Emotional Adjustment scales demonstrated acceptable to high internal consistency ($\alpha = .90, .91, .71$, respectively).

Nutrition

Parents recorded all food and drink their child consumed over a 3-day period (including two week days and one weekend day). Total energy intake (kilojoules) was analysed using Foodworks 8 Professional nutrition software (Xyris Software, Australia).

Physical activity

The target child wore an accelerometer for 7 days to assess physical activity levels at each assessment time point (GT3X and GT3X plus models, Actigraph, Pensacola, Florida). Accelerometry is considered the gold standard objective measure of child activity levels (Trost, McIver, & Pate, 2005). Devices were worn over the right hip via a waist belt, as placement here is more valid and less obtrusive (Sirard, Trost, Pfeiffer, Dowda, & Pate, 2005). Parents were instructed to ensure their child wore the accelerometer at all times (excluding during water-based activities). Analysis was performed using ActiLife6 software (Pensacola, Florida), with a 15-second sampling interval to detect the spontaneous activity of children. At least 4 days of

valid data was needed, and to meet criteria for a valid day the accelerometer must have been worn for a minimum of 8 hours per day. Cut-points were used to distinguish different intensities of physical activity (Evenson, Catellier, Gill, Ondrak, & McMurray, 2008). Total minutes of moderate-to-vigorous intensity physical activity (MVPA) and percentage of time spent in MVPA was assessed. To promote wear compliance, information sheets were given to caregivers and teachers. Parents also kept an activity log during the wear period to provide information regarding when the device was taken off.

Screen-based behaviour

Total weekly time (in minutes) viewing television, playing electronic games, and computer use was assessed via parental report.

Parenting

The *Parenting Scale* (PS; Arnold, O’Leary, Wolff, & Acker, 1993) measured overall dysfunctional parenting (PS Total), and three dysfunctional discipline styles (Laxness [permissive discipline], Overreactivity [authoritarian discipline, displays of anger], and Verbosity [overly long reprimands or reliance on talking]). The internal consistencies were high for PS Total, Laxness, and Overreactivity ($\alpha = .84, .84, \text{ and } .83$, respectively), however Verbosity was poor ($\alpha = .42$).

The *Lifestyle Parenting Questionnaire* (LPQ) was a new 23-item measure designed to assess lifestyle-specific parent behaviour. Parents rate the frequency of each behaviour on a 5-point scale from *never* (0) to *almost always* (4). Example behaviours include serving water with meals, eating at a table, and involving children in the cooking process. Higher scores represent increased use of healthy lifestyle parental behaviours. The LPQ Total had acceptable internal consistency ($\alpha = .75$).

Parental confidence

The Confidence subscale of the LBC was used to assess parental confidence in dealing with lifestyle-specific child behaviour problems. Higher scores represent greater levels of confidence. Internal consistency was excellent ($\alpha = .96$).

The CAPES Efficacy subscale was used to assess parental self-efficacy in dealing with child general child behaviour, with higher scores indicating higher levels of efficacy. Internal consistency was excellent ($\alpha = .95$).

Anthropometric measurements

All assessors were trained to conduct measurements according to standard procedures detailed by Davies and colleagues (2001). Electronic scales (Seca, Model 803, Hamburg, Germany) were used to measure weight to the nearest 0.1 kg. A portable stadiometer assessed height to the nearest 0.1 cm (Seca, Model 213, Hamburg, Germany). Parent BMI and child BMI z-scores were then calculated. The international standard definitions were used to classify BMI into underweight, healthy weight, overweight and obese (Cole, Bellizzi, Flegal, & Dietz, 2000; World Health Organisation, 2000). Child age- and sex-specific BMI z-scores were derived from the L (lambda), M (mu), S (sigma) parameters published by the Centre for Disease Control (CDC; Kuczmarski et al., 2000). Waist measurements were taken using non-extensible steel tape (Seca, Model 203, Hamburg, Germany) to the nearest 0.1 cm. Measurements were taken at midpoint between the iliac crest and lower rib using umbilicus as a secondary reference point.

Client satisfaction

The *Consumer Satisfaction Questionnaire* (CSQ; West & Sanders, 2010) asked parents to rate the quality of the service provided, how well the intervention met parental needs, child progress, and general comments about the intervention.

Statistical analyses

Data was analysed using SPSS 23.0 (SPSS Inc, Chicago, IL). The efficacy of the intervention was tested using a series of mixed-model repeated measures (MMRM) regression models for each outcome on the intent-to-treat sample (Hedeker & Gibbons, 2006). A restricted maximum likelihood solution was used to fit the models in order to include all randomised participants in data analysis.

Time (categorical: Time 1 [coded as 0], Time 2 [coded as 1], Time 3 [coded as 2], Time 4 [coded as 3], *condition* (categorical: intervention and control), and the *time-by-condition* interaction were entered as fixed effects. Random *intercepts* were included in each model to account for variation between participant's baseline scores. Random slopes for *time* were included for each model to account for variation between participants in rates of change over time. For models with both random slopes and random intercepts an unstructured covariance matrix was used. Residual within-person errors were estimated using an identity covariance matrix. For MMRMs with significant time-by-condition interaction effects, individual models for each condition were also run to identify the source of the significant effect. Follow-up *t*-tests were then conducted to determine whether the slope of each condition was significantly different from zero.

Effect sizes were calculated as mean change from pre-intervention to Time 4 in the intervention condition minus mean change from pre-intervention to Time 4 in the control condition, divided by pooled pre-intervention standard deviation and applying a bias-correction for small sample sizes (Morris, 2008). Effect sizes were interpreted as: small (≥ 0.2), medium (≥ 0.5) and large (≥ 0.8) (Cohen, 1992).

Clinical significance of change was explored using two methods: (1) chi-square analyses of the proportion of participants moving from the clinically elevated to non-clinical range at Time 4, based on published cutoffs (Kendall, Marris-Garcia, Nath, & Sheldrick, 1999); and

(2) reliable change indices (RCI) were calculated using the standard deviation of pre-intervention scores and published test-retest reliabilities (Jacobson & Truaz, 1991), in order to examine the extent to which change from Time 1 to Time 4 was reliable or unlikely due to chance.

Results

Preliminary analyses

Chi-squared tests of independence for the categorical variables and independent samples *t*-tests for the continuous variables were conducted in order to compare the intervention and control conditions across demographic and outcome variables. No significant differences between conditions were found (see Table 2).

Attrition

Overall 18.96% of total score values were missing from Time 1 to Time 4. A missing values analysis indicated that data was missing completely at random (MCAR), with Little's test not reaching significance, $\chi^2(1649) = 267.29, p = 1.000$. The proportion of participants who were lost to follow-up over the course of the study did not differ significantly between intervention (26/80) and control conditions (24/80), $\chi^2(1, n = 160) = 0.03, p = .854$.

Intention-to-treat analyses were used to ensure all participants were included in the analyses.

Protocol adherence

Of the 69 treatment completers: 60 completed all sessions, 6 completed 2 sessions, and 3 completed 1 session. Four make-up sessions were conducted face-to-face. The majority of missed sessions were due to work commitments or parent/child illness. Protocol adherence checklists completed by the practitioner indicated that 98% of content was covered. The inter-rater reliability, measure as the agreement between the practitioner and independent rater, was 100%.

Intervention effects

MMRM linear regression was used to compare the rate of change for individuals in the intervention and control condition across the range of outcome variables from Time 1 to Time 4. Intervention effects for the primary outcomes along with means, standards deviations and effect sizes are reported in Table 3.

Parenting

MMRM analysis revealed a significant time-by-condition interaction on PS Total scores suggesting that the rate of change was moderated by condition. Follow-up contrasts revealed that the rate of decrease in PS Total scores from Time 1 to Time 4 was significantly greater for parents in the intervention condition ($\beta_{\text{INT}} = -.17, p < .001$), compared to the control condition ($\beta_{\text{CON}} = -.04, p = .017$), $t(156) = 4.28, p < .001$.

When PS scores were examined by subscale, there was a significant time-by-condition interaction for Verbosity, Laxness, and Overreactivity. Follow-up contrasts showed that the rate of decrease in Laxness scores from Time 1 to Time 4 was significantly greater for parents in the intervention condition ($\beta_{\text{INT}} = -.18, p < .001$) compared to the control condition, who showed no significant change ($\beta_{\text{CON}} = -.03, p = .240$), $t(156) = 3.95, p < .001$. Similarly, rates of decrease in Overreactivity scores from Time 1 to Time 4 was significantly greater for parents in the intervention condition ($\beta_{\text{INT}} = -.14, p < .001$), compared to control parents ($\beta_{\text{CON}} = -.05, p = .039$), $t(156) = 2.29, p = .023$. Verbosity scores from Time 1 to Time 4 also significantly reduced more in the intervention condition ($\beta_{\text{INT}} = -.22, p < .001$), compared to the control ($\beta_{\text{INT}} = -.07, p = .006$), $t(156) = 3.47, p < .001$. The time-by-condition interaction for LPQ Total was not significant.

Parenting confidence

The CAPES Efficacy subscale showed a significant time-by-condition interaction suggesting that the rate of change was moderated by condition. Follow-up contrasts revealed

that the rate of increase in Efficacy scores from Time 1 to Time 4 was significantly greater for parents in the intervention condition ($\beta_{\text{CON}} = 9.72, p < .001$), compared to the control condition ($\beta_{\text{INT}} = 4.48, p = .001$), $t(156) = -2.63, p = .009$.

On the LBC Confidence subscale, the time-by-condition interaction was significant. Follow-up contrasts showed that the rate of increase from Time 1 to Time 4 in LBC Confidence scores was significantly greater in the intervention condition ($\beta_{\text{INT}} = 9.22, p < .001$), compared to the control condition ($\beta_{\text{CON}} = 4.11, p = .009$), $t(156) = -2.11, p = .037$.

Child behaviour

MMRM analysis of LBC Problem scores showed a significant time-by-condition interaction suggesting that the rate of change was moderated by condition. Follow-up contrasts showed that the rate of decrease in Problem scores from Time 1 to Time 4 was significantly greater for parents in the intervention condition ($\beta_{\text{INT}} = -3.13, p < .001$), compared to the control, who showed no significant change from Time 1 to Time 4 ($\beta_{\text{INT}} = -1.13, p = .053$), $t(156) = 2.29, p = .023$. The time-by-condition interactions for CAPES Intensity, Behaviour and Emotional Adjustment scales were not significant.

Anthropometric measurements

Time was a significant predictor of change in child BMI z-scores ($\beta = -0.05, F(1, 118) = -2.86, p = .005$) and weight z-scores ($\beta = -0.21, F(1, 147) = 5.25, p = .023$). However, no significant time-by-condition interaction was found for BMI z-scores or weight z-scores, which suggests that change was not moderated by condition for these variables. There was also no significant time-by-condition interaction for waist circumference and parent BMI.

Subgroup analyses were conducted using only overweight children to determine whether intervention effects were being masked by the inclusion of healthy weight children. However, there was no change in the significance or interpretation of outcomes. Subgroup analyses were not included in this report for the sake of brevity.

Nutrition

No significant time-by-condition interaction was found for total energy intake scores.

Physical activity

No significant time-by-condition interactions were observed for time spent in moderate-to-vigorous physical activity (MVPA) in minutes or as a percentage of total time per day.

Screen-based behaviour

MMRM analyses revealed that time was a significant predictor of change in total time spent watching television per week ($\beta = 46.13$, $F(1, 230) = 5.89$, $p = .016$). A significant time-by-condition interaction was also found suggesting that the rate of change was moderated by condition. Follow-up contrasts showed that the rate of increase in television viewing from Time 1 to Time 4 was significantly greater for parents in the control condition ($\beta_{\text{CON}} = 46.80$, $p = .027$), compared to the intervention, ($\beta_{\text{INT}} = -17.09$, $p = .276$), $t(156) = 2.46$, $p = .015$), who showed no significant change. No significant time-by-condition interactions were found for time spent playing electronic games or computer use.

Clinical significance of change

Table 4 shows the proportion of reliable change, and the proportion of clinically and reliably significant change from Time 1 to Time 4.

Chi-squared tests for independence indicated that a significantly greater proportion of intervention participants, compared to those in the control condition, showed reliable improvements from Time 1 to Time 4 for PS Total, Laxness, Overreactivity, and CAPES Intensity scores. There was no association between the condition allocated and reliable worsening on any measures.

The proportion of clinical change from Time 1 to Time 4 differed significantly as a function of condition for PS Total, Laxness, and Overreactivity. Of those scoring in the clinical range for PS Total at Time 1, 23% of intervention participants moved into the non-

clinical range by Time 4, compared to 3% of those in the control condition. Furthermore, more participants in the intervention condition moved from the clinical to non-clinical range by Time 4 than participants in the control condition for PS Laxness (17% versus 2%, respectively) and PS Verbosity (27% versus 6%, respectively).

Intervention acceptability

Overall, parents reported the program was a high quality intervention ($M = 6.16$, $SD = 0.80$). Most parents received the type of help they wanted (94%), and gained the information needed to implement parenting strategies (97%). The majority of parents were satisfied with the overall program (90%). All parents intended to implement the strategies learnt. Parents reported that the program helped with both lifestyle-specific behaviour (90%), and general child behaviour (94%).

Discussion

This evaluation of the Lifestyle Triple P Seminar Series demonstrated beneficial improvements in both parent and child outcomes. Following the intervention, significant improvements were found for general parenting style, general and lifestyle-specific parental confidence, and child lifestyle-specific problem. A greater mean reduction in child BMI z -scores was found in the intervention condition, however this was not statistically significant.

Comparison of the effect sizes for the overall dysfunctional parenting, laxness and verbosity measures suggest that the improvements in dysfunctional parenting observed at 12-months follow-up were superior to the existing Lifestyle Triple P 14-week program for children who are already overweight or obese (West, Sanders, Cleghorn & Davies, 2010). This may be explained by taking into account that the 14-week program includes only overweight and obese children, whereas the 3-week seminar included a mix of children of varying weight status, including 63% in the healthy weight range. Parents with healthy

weight children may be more receptive to parenting guidance resulting in larger improvements in parenting behaviours.

The findings of this study support the principle of minimal sufficiency in the delivery of parenting interventions (Sanders, 2012). The results suggest that not all parents require an intensive level of intervention to achieve long-term intervention benefits. This is further supported by comparable effect sizes found in other evaluations of brief Triple P interventions (Sumargi, Sofronoff, & Morawska, 2015; Sofronoff, Jahnel, & Sanders, 2011). It should be noted, however, that the PS Verbosity subscale had poor internal consistency in this study, and therefore results from this measure should be interpreted with care.

Condition differences were not significant for child BMI *z*-scores, however a clear trend could be observed in the predicted direction, suggesting that the program had a degree of impact on child body size. The lack of significance in the change of BMI *z*-scores post-intervention could be explained by the fact that 63% of children in the study were in the healthy weight range, and therefore unlikely to have any change in BMI *z*-scores. The 14-week Lifestyle Triple P program (West, Sanders, Cleghorn & Davies, 2010) found positive effects on child weight at 12-months follow-up with a more obese sample of children (mean BMI *z*-score of 2.11 versus 0.59 in this study). This study may have been insufficiently powered to observe significant change in BMI given the small number of overweight children in the cohort. Future research could evaluate the efficacy of this program with overweight children only to determine its influence on child body size parameters.

Alternatively, it could be that group differences were not observed for BMI *z*-scores due to a sleeper effect not detectable at 12-months. Parents may have needed greater than 12-months to practice and use the parenting strategies they learnt during the program to influence child behaviours that impact on weight. The feasibility of long-term studies is extremely limited,

and very few studies have analysed the effects of lifestyle-specific parenting interventions 5-years post-treatment (Reinhr, 2013).

One limitation of the current study is that the sample was predominately mothers (92%), with only 8% father outcome data. Father outcome data is relatively underrepresented in the parenting literature (Fletcher, Freeman, & Matthey, 2011; Well, Sarkadi, & Salari, 2016), and emerging research suggests that fathers play an important role in the development of child lifestyle behaviour (Fraser, Skouteris, McCabe, Ricciardelli, Milgrom, & Baur, 2011; Wake, Nicholson, Hardy, & Smith, 2007; Stein, Epstein, Raynor, Kilanowski, & Paluch, 2005). Future research should investigate the effectiveness of this intervention with father outcome data.

Another limitation of the study was that parents were able to access other support services during the 12-month assessment period. The lack of an intervention effect for child BMI may be explained by parents in the control group accessing lifestyle support during this period. Future research should monitor parental access to support services during the assessment phase.

Future evaluation trials should investigate predictors of treatment outcomes by performing mediator and moderator analyses. This would allow identification of whether certain families benefit more from the intervention, and elucidate mechanisms of change responsible for intervention effects.

The potential benefits of this program are substantial. A successful short program delivered to all children at a young age could have meaningful implications for public health. Participation can be seen as being universal and health orientated. It has the capacity to effect a long-term change in attitudes towards healthy living in both child and parent. There is potential for this program to produce additional effects for public health problems beyond

obesity, such as prevention of disordered eating. The health burden of obesity, diabetes and other chronic lifestyle related diseases could be significantly reduced.

Conclusion

A new brief parenting program (Lifestyle Triple P Seminar Series) was assessed with a RCT and 12-month follow-up. The program achieved improvements in lifestyle-specific and general parenting confidence, parenting styles, and child lifestyle behaviour. The benefits of this program are its briefness and universal application making it an ideal tool for achieving population level changes in childhood obesity.

References

- Arnold, D. S., O'Leary, S. G., Wolff, L. S., & Acker, M. M. (1993). The Parenting Scale: A measure of dysfunctional parenting in discipline situations. *Psychological Assessment*, 5, 137–144. doi: 10.1037/1040-3590.5.2.137
- Bauman, A. E. (2004). Updating the evidence that physical activity is good for health: an epidemiological review 2000-2003. *Journal of Science and Medicine in Sport*, 7, 6-19. doi: 10.1016/S1440-2440(04)80273-1
- Birch, L. L., & Ventura, A. K. (2009). Preventing childhood obesity: what works? *International Journal of Obesity*, 33, s74-81. doi: 10.1038/ijo.2009.22
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112, 115-159.
- Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal*, 320, 1240–1243.
- Crowle, J. & Turner, E. (2010). *Childhood obesity: An economic perspective*. Productivity Commission Staff Working Paper, Melbourne, VIC. Retrieved from <http://www.pc.gov.au/research/supporting/childhood-obesity/childhood-obesity.pdf>
- Davies, P. S. W., Roodvelt, R., & Marks, G. (2001). *Standard methods for the collection and collation of anthropometric data in children*. Canberra, ACT: Commonwealth of Australia.
- Evenson, K. R., Catellier, D. J., Gill, K., Ondrak, K.S., McMurray, R.G. (2008). Calibration of two objective measures of physical activity for children. *Journal of Sports Science*, 26, 1557–1565. doi: 10.1080/02640410802334196.
- Fraser, J., Skouteris, H., McCabe, M., Ricciardelli, L. A., Milgrom, J., & Baur, L. A. (2011). Paternal influences on children's weight gain: a systematic review. *Fathering*, 9, 252-267. doi: 10.3149/fth.0903.252

- Fletcher, R., Freeman, E., & Matthey, S. (2011). The impact of behavioural parent training on fathers' parenting: A meta-analysis of the Triple P-Positive Parenting Program. *Fathering*, 9, 291-312. doi: 10.3149/fth.0903.291
- Golan, M., & Crow, S. (2004). Targeting parents exclusively in the treatment of childhood obesity: long-term results. *Obesity Research*, 12, 357–361. doi: 10.1038/oby.2004.45
- Golan, M., Weizman, A., Apter, A., & Fainaru, M. (1998). Parents as the exclusive agents of change in the treatment of childhood obesity. *The American Society for Clinical Nutrition*, 67, 1130-1135.
- Hedeker, D., & Gibbons, R. (2006). *Longitudinal data analysis*. Hoboken, NJ: Wiley-Interscience.
- Jacobson, N.S., & Truax, P. (1991). Clinical significance: A statistical approach to defining meaningful change in psychotherapy research. *Journal of Consulting and Clinical Psychology*, 59, 12–19.
- Kendall, P. C., Marrs-Garcia, A., Nath, S. R., & Sheldrick, R. C. (1999). Normative comparisons for the evaluation of clinical significance. *Journal of Consulting and Clinical Significance*, 67, 285-299.
- Kuczmarski, R. J., Ogden, C. L., Grummer-Strawn, L. M., Flegal, K. M., Guo, S. S., ... Johnson, C. L. (2000). CDC growth charts: United States. Hyattsville, MD: National Center for Health Statistics.
- Lindsay, A. C., Sussner, K. M., Kim, J., & Gortmaker, S. L. (2006). The role of parents in preventing childhood obesity. *The Future of Children*, 16, 169-186.
- Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: a crisis in public health. *Obesity Reviews*, 5, 4-85. doi: 10.1111/j.1467-789X.2004.00133.x
- Lovibond, S. H., & Lovibond, P. F. (1995). *Manual for the Depression Anxiety Stress Scales* (2nd ed.). Sydney: Psychology Foundation of Australia.

- Mamun, A. A., Lawlor, D. A., O'Callaghan, M. J., Williams, G. M., & Najman, J. M. (2005). Family and early life factors associated with changes in overweight status between ages 5 and 14 years: Findings from the Mater University Study of Pregnancy and its outcomes. *International Journal of Obesity*, 29, 475–482. doi: 10.1038/sj.ijo.0802922
- Morawska, A., Sanders, M. R., Haslam, D. M., Filus, A., & Fletcher, R. (2014). Child Adjustment and Parent Efficacy Scale (CAPES): Development and initial validation of a parent report measure. *Australian Psychologist*, 49, 241–252. doi: 10.1111/ap.12057
- Nguyen, B., McGregor, K. A., O'Connor, J., Shrewsbury, V. A., Lee, A., Steinbeck, K. S., Hill, A. J., Shah, S., Kohn, M. R. & Baur, L. A. (2012). Recruitment challenges and recommendations for adolescent obesity trials. *Journal of Paediatrics and Child Health*, 48, 38-43. doi: 10.1111/j.1440-1754.2011.02183.x
- Rampersaud, G. C., Pereira, M. A., Girard, B. L., Adams, J., & Metz, J. D. (2005). Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. *Journal of the American Dietetic Association*, 105, 743–760. doi: 10.1016/j.jada.2005.02.007
- Reinehr, T. (2013). Lifestyle intervention in childhood obesity: Changes and challenges. *Nature Reviews Endocrinology*, 9, 607-614. doi: 10.1038/nrendo.2013.149
- Sirard, J. R., Trost, S. G., Pfeiffer, K. A., Dowda, M., & Pate, R. R. (2005). Calibration and evaluation of an objective measure of physical activity in preschool children. *Journal of Physical Activity & Health*, 2, 345–357.
- Gerards, S. M. P., Sleddens, E. F. C., Dagnelie, P. C., De Vries, N. K., & Kremers, S. P. J. (2001). Interventions addressing general parenting to prevent or treat childhood obesity. *International Journal of Pediatric Obesity*, 6, e28-e45. doi: 10.3109/17477166.2011.575147

- Stein, R., Epstein, L., Raynor, H., Kilanowski, C., & Paluch, R. (2005). The influence of parenting change on pediatric weight control. *Obesity, 13*, 1749-1755. doi: 10.1038/oby.2005.213
- Sofronoff, K., Jahnel, D., & Sanders, M. R. (2011). Stepping Stones Triple P Seminars for parents of a child with a disability: A randomized controlled trial. *Research in Developmental Disabilities, 32*, 2253-2262. doi: 10.1016/j.ridd.2011.07.046
- Sumargi, A., Sofronoff, K., & Morawska, A. (2015). A randomized-controlled trial of the Triple P – Positive Parenting Program Seminar Series with Indonesian parents. *Child Psychiatry & Human Development, 46*, 749-761. doi: 10.1007/s10578-014-0517-8
- Sung-Chan, P., Sung, Y. W., Zhao, X., & Brownson, R. C. (2013). Family-based models for childhood obesity intervention: A systematic review of randomized controlled trials. *Obesity Review, 14*(4), 265-278. doi: 10.1111/obr.12000.
- Trost, S. G., Mciver, K. L., & Pate, R. R. (2005). Conducting accelerometer-based activity assessments in field-based research. *Medicine & Science in Sports & Exercise, 37*, s531–s543. doi:10.1249/01.mss.0000185657.86065.98
- Wake, M., Nicholson, J. M., Hardy, P., & Smith, K. (2007). Preschooler obesity and parenting styles of mothers and fathers: Australian national population study. *Pediatrics, 120*, e1520-1527.
- Wells, M. B., Sarkadi, A., & Salari, R. (2016). Mothers' and fathers' attendance in a community-based universally offered parenting program in Sweden. *Scandinavian Journal of Public Health, 44*, 274-280. doi: 10.1177/1403494815618841
- West, F. & Sanders, M. R. (2009). The Lifestyle Behaviour Checklist: A measure of weight-related problem behaviour in obese children. *Journal of Pediatric Obesity, 4*(4), 266–273. doi: 10.3109/17477160902811199

- West, F. & Sanders, M. R. (2010). *Facilitator's manual for Group Lifestyle Triple P*.
Brisbane, Australia: Triple P International.
- West, F., Sanders, M. R., Cleghorn, G. J., & Davies, P. S. (2010). Randomised clinical trial of a family-based lifestyle intervention for childhood obesity involving parents as the exclusive agents of change. *Behaviour Research & Therapy*, 48, 1170-1179. doi: 10.1016/j.brat.2010.08.008
- World Health Organisation. (2000). *Obesity: Preventing and managing the global epidemic: Report of a WHO consultation* (No. 894 WHO Technical Report Series). Geneva, Switzerland: World Health Organisation.
- World Health Organisation. (2012). Population-based approaches to childhood obesity prevention. Geneva, Switzerland: World Health Organisation.

Table 2.*Demographic characteristics of the intervention and control group.*

Variable	Intervention (<i>n</i> = 80)		Control (<i>n</i> = 80)			
Continuous	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Child age (years)	5.96	1.86	6.00	1.97	0.15	.882
Parent age (years)	39.50	4.96	38.40	5.04	-1.39	.166
Number of children	2.18	0.86	2.16	0.87	-0.11	.914
Depression	2.70	3.46	2.70	3.20	-0.25	.801
Anxiety	1.63	2.49	1.50	1.77	-0.38	.703
Stress	5.12	3.60	5.74	4.22	0.98	.327
Categorical	<i>n</i>	%	<i>n</i>	%	χ^2	<i>p</i>
Child sex						
Male	38	48	31	39	3.05	.081
Female	42	52	49	61		
Parent sex						
Male	7	9	5	6	0.36	.548
Female	73	91	75	94		
Child weight status						
Underweight	2	3	1	1	1.78	.619
Healthy weight	53	66	48	60		
Overweight	12	15	18	23		
Obese	13	16	13	16		
Parent weight status						
Underweight	1	1	1	1	1.08	.782
Healthy weight	32	40	32	40		
Overweight	29	36	24	30		
Obese	18	23	23	29		
Household ^a						
Original biological parents	65	83	63	80	0.39	.825
An original and step parent	2	3	2	2		
Sole parent	11	14	14	18		
Marital status ^a						
Married	56	72	60	76	0.35	.553
Single/Divorced/Separated	22	28	19	24		
Parent country of birth ^b						
Australia/New Zealand	52	68	65	82	8.56	.200
South East Asia	3	4	3	4		
United Kingdom	7	9	7	9		
Middle East	2	3	0	0		
Asia	2	3	0	0		
South Africa	5	6	3	4		
Western Europe	5	6	1	1		
Child Ethnicity ^a						
Not Aboriginal/Torres Strait	76	97	78	99	0.35	.552
Aboriginal	2	3	1	1		

Variable	Intervention (<i>n</i> = 80)		Control (<i>n</i> = 80)			
Continuous	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Parent's education ^a						
Senior high school	12	15	9	12	0.60	.896
University degree	26	33	27	34		
Postgraduate degree	27	35	28	35		
Tafe/College/Diploma	13	17	15	19		
Parent employed ^a						
No	26	33	17	22	2.76	.097
Yes	52	67	62	78		
Annual income (AUD) ^a						
< \$20,799	2	3	2	3	7.94	.338
\$20,800 - \$31,199	0	0	6	8		
\$31,200 - \$41,599	3	4	1	1		
\$41,600 - \$51,999	2	3	2	3		
\$52,000 - \$67,599	9	11	7	9		
\$67,600 - \$83,199	8	10	6	8		
\$83,200 - \$103,999	11	14	14	18		
> \$104,000	43	55	41	50		
Able to meet household expenses ^a						
No	12	15	16	20	1.69	.430
Yes	66	85	62	79		
Don't know	0	0	1	1		
After expenses can afford ^a						
Nothing	15	19	12	15	1.91	.385
Some things	30	38	39	50		
Most things	33	42	28	35		
Previous support received ^c						
Yes	10	13	8	10	0.28	.597
No	69	87	72	90		

^aData missing for 2 intervention cases and 1 control case; ^bData missing for 4 intervention cases and 1 control case; ^cData missing for 1 intervention case; DASS = Depression, Anxiety and Stress Scale; AUD = Australian dollars.

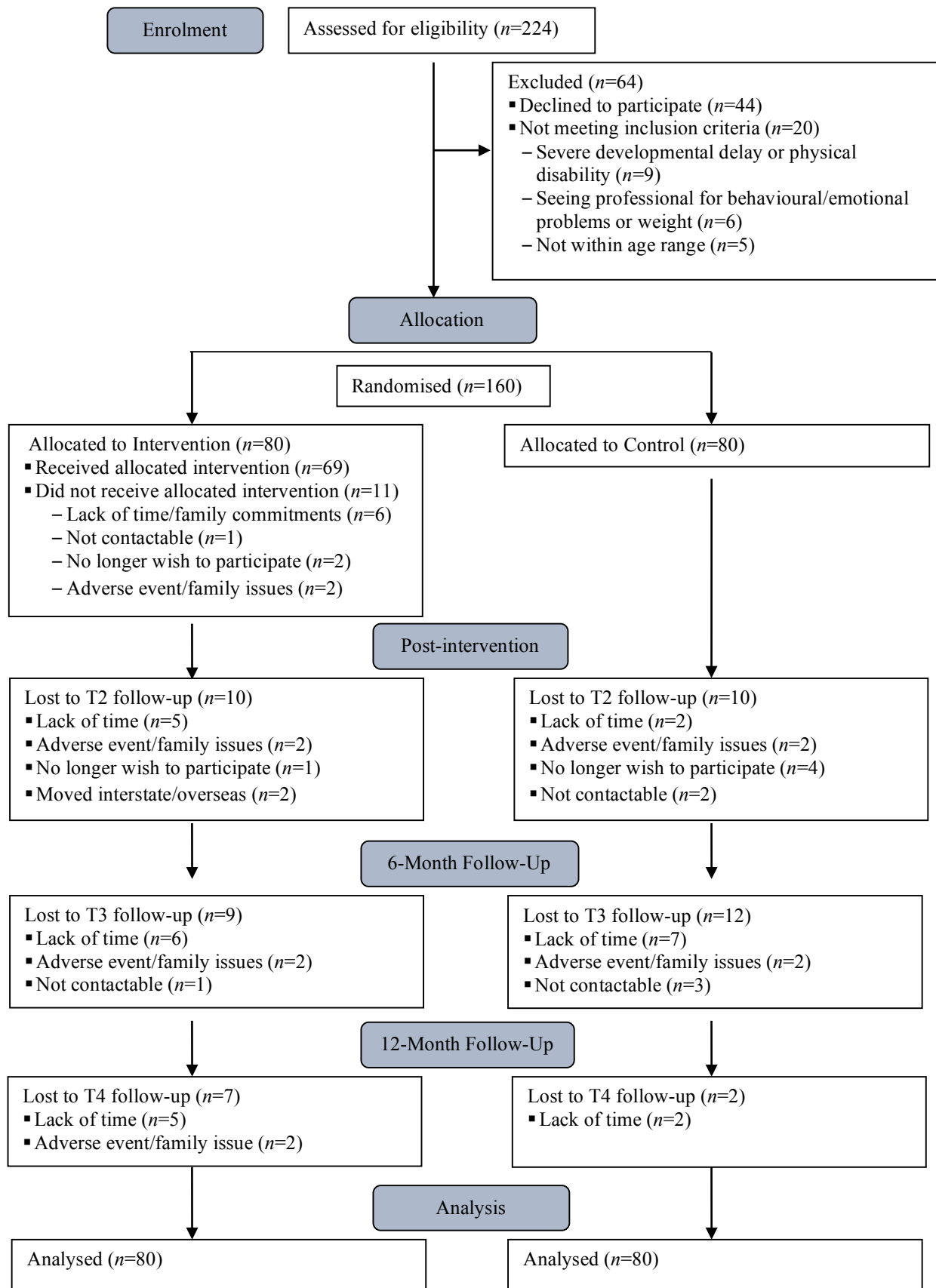


Figure 7. CONSORT diagram of flow of participants.

Table 3. Intervention effects for parent and child outcomes by condition.

Measure	Intervention (<i>n</i> = 80)				Control (<i>n</i> = 80)				Estimate of fixed effects: time x condition interaction term ^c				Effect size
	T1 <i>M</i> (<i>SD</i>)	T2 <i>M</i> (<i>SD</i>)	T3 <i>M</i> (<i>SD</i>)	T4 <i>M</i> (<i>SD</i>)	T1 <i>M</i> (<i>SD</i>)	T2 <i>M</i> (<i>SD</i>)	T3 <i>M</i> (<i>SD</i>)	T4 <i>M</i> (<i>SD</i>)	β	<i>F</i>	<i>df</i>	<i>p</i>	T1-T4 <i>d</i> [95% CI]
BMI <i>z</i> -score	0.50 (1.13)	0.56 (1.16)	0.51 (1.36)	0.30 (1.15)	0.67 (1.05)	0.71 (1.07)	0.39 (1.25)	0.49 (1.17)	-0.01	0.00	118.36	.958	<i>ns</i>
Weight <i>z</i> -score	1.12 (2.87)	0.29 (1.41)	-0.04 (1.42)	0.22 (1.19)	0.72 (1.19)	0.17 (1.30)	0.17 (2.85)	0.07 (1.59)	-0.13	1.00	147.00	.318	<i>ns</i>
Waist (cm)	58.40 (9.74)	60.18 (10.71)	61.24 (11.22)	60.73 (9.93)	58.83 (8.70)	59.74 (9.51)	59.98 (9.32)	61.53 (9.66)	0.25	1.61	196.09	.206	<i>ns</i>
Parent BMI	26.92 (5.71)	27.56 (6.24)	27.08 (6.25)	26.83 (4.87)	27.49 (6.67)	28.48 (10.20)	27.37 (5.99)	27.38 (6.31)	-0.08	0.08	481.07	.779	<i>ns</i>
PS Total	3.21 (0.63)	2.89 (0.68)	2.68 (0.68)	2.66 (0.66)	3.24 (0.59)	3.19 (0.58)	3.10 (0.61)	3.09 (0.62)	-0.13	18.45	245.36	.000	0.65 [0.34-0.97]
PS Laxness	2.91 (0.84)	2.60 (0.91)	2.31 (0.77)	2.31 (0.86)	2.84 (0.86)	2.77 (0.79)	2.75 (0.81)	2.74 (0.79)	-0.14	12.67	305.37	.000	0.59 [0.27-0.90]
PS Overreactive	3.13 (0.90)	2.75 (0.76)	2.65 (0.79)	2.62 (0.69)	3.26 (0.82)	3.27 (0.89)	3.10 (0.83)	3.08 (0.81)	-0.10	6.70	229.06	.010	0.38 [0.07-0.69]
PS Verbosity	3.84 (0.80)	3.38 (0.86)	3.13 (0.95)	3.12 (0.90)	3.86 (0.72)	3.80 (0.76)	3.61 (0.85)	3.63 (0.78)	-0.16	13.55	212.20	.000	0.64 [0.32-0.96]
LBC Problem	62.60 (19.88)	56.76 (18.23)	52.29 (17.18)	54.87 (17.22)	64.60 (20.88)	64.51 (20.56)	64.28 (22.98)	61.73 (22.12)	-2.04	5.47	384.50	.020	0.24 [-0.07-0.55]
LBC Confidence	176.92 (47.02)	196.46 (49.36)	213.36 (31.08)	208.91 (33.75)	169.76 (38.65)	177.03 (41.69)	174.52 (44.13)	183.52 (43.21)	6.05	7.14	217.88	.008	0.42 [0.11-0.73]

LPQ	58.18	62.86	63.82	62.57	56.63	56.84	56.87	57.36	0.50	1.20	251.80	.274	0.37
Total	(10.37)	(8.73)	(7.86)	(9.16)	(9.11)	(8.44)	(6.91)	(9.07)					[0.06-0.68]
CAPES	131.13	156.41	166.54	162.04	125.04	130.21	131.97	141.02	4.73	5.67	216.59	.018	0.43
Efficacy	(35.84)	(32.40)	(25.87)	(29.80)	(33.71)	(32.61)	(36.69)	(33.01)					[0.12-0.74]
CAPES	25.92	22.74	22.20	20.86	29.43	29.13	27.20	25.63	-0.34	0.36	228.28	.549	<i>ns</i>
Intensity	(10.81)	(9.87)	(11.14)	(10.12)	(12.16)	(11.05)	(10.70)	(11.62)					
CAPES	23.96	20.91	20.46	19.06	27.00	26.66	24.89	23.24	-0.42	0.63	233.04	.429	<i>ns</i>
Behaviour	(10.35)	(9.53)	(10.84)	(9.99)	(11.41)	(10.37)	(9.96)	(10.80)					
CAPES	1.96	1.83	1.75	1.85	2.43	2.47	2.31	2.36	0.06	0.35	220.42	.556	<i>ns</i>
Emotional	(1.62)	(1.59)	(1.57)	(1.72)	(2.01)	(2.16)	(1.90)	(1.99)					
Energy intake	8991.73	8215.29	10923.01	13807.27	9674.43	9414.58	11124.65	12942.88	52.94	0.00	347.68	.947	<i>ns</i>
(kilojoules)	(4526.50)	(3960.69)	(12515.62)	(19479.20)	(5426.11)	(4403.18)	(10426.61)	(15738.92)					
MVPA	56.09	53.23	54.87	57.56	57.68	56.99	51.49	59.17	0.47	0.20	169.08	.653	<i>ns</i>
average	(20.09)	(22.43)	(22.83)	(21.20)	(23.38)	(22.80)	(18.71)	(23.11)					
MVPA	7.84	7.51	7.77	8.06	8.11	7.94	7.16	8.35	0.07	0.24	186.75	.625	<i>ns</i>
(%)	(2.77)	(2.95)	(3.01)	(3.01)	(3.22)	(2.93)	(2.55)	(3.33)					
Watching TV	522.63	428.00	441.67	431.97	525.54	561.08	643.65	635.66	-70.95	6.60	233.22	.011	0.59
	(320.09)	(247.35)	(271.06)	(236.84)	(348.71)	(371.00)	(333.45)	(499.54)					[0.03-0.16]
Electronic	186.99	138.45	160.81	182.88	169.66	177.25	206.88	235.46	-24.98	1.72	239.99	.191	<i>ns</i>
games	(259.16)	(200.17)	(182.72)	(207.35)	(186.12)	(201.57)	(218.19)	(231.23)					
Computer use	53.60	42.18	46.59	58.64	43.00	42.25	58.02	56.76	-6.04	0.41	175.34	.524	<i>ns</i>
	(97.18)	(148.91)	(108.11)	(146.22)	(105.91)	(99.57)	(145.24)	(123.85)					

Note. T1 = time 1 (pre-intervention); T2 = time 2 (post-intervention); T3 = time 3 (6-month follow-up); T4 = time 4 (12-month follow-up); BMI = body mass index; PS = Parenting Scale; LBC = Lifestyle Behaviour Checklist; LPQ = Lifestyle Parenting Questionnaire; CAPES = Child and Adjustment and Parent Efficacy Scale; ^cβ = estimated regression coefficient using mixed-model repeated measures regression. Figures indicate the estimated change in the intervention condition from Time 1 to Time 4 relative to the control condition. ^dEffect size represents the mean change from pre-intervention to Time 4 in the intervention condition minus the mean change from pre-intervention to Time 4 in the control condition, divided by the pooled baseline standard deviation for the measure.

Table 4. Reliable change for Time 1 to Time 4.

Measure	Condition	Reliably improved			Reliably and clinically improved			Reliably worsened			No change
		% (n/n)	χ^2 ^a	<i>p</i>	% (n/n)	χ^2 ^a	<i>p</i>	% (n/n)	χ^2 ^a	<i>p</i>	% (n/n)
BMI z score	Intervention	4 (2/46)	0.15	1.000	0 (0/57)	0.96	1.000	0 (0/46)	0.00	1.000	96 (44/46)
	Control	6 (3/49)			2 (1/60)			0 (0/49)			94 (46/49)
PS Total	Intervention	37 (19/52)	13.30	<.001	23 (12/68)	7.02	.004	2 (1/52)	0.00	1.000	62 (32/52)
	Control	6 (3/53)			3 (2/72)			2 (1/53)			75 (40/53)
PS Laxness	Intervention	23 (12/53)	6.85	.004	17 (9/71)	5.16	.017	6 (3/53)	0.00	.678	66 (35/53)
	Control	4 (2/54)			2 (1/72)			4 (2/54)			91 (50/54)
PS Overreactivity	Intervention	32 (17/53)	7.19	.004	17 (9/71)	2.58	.073	2 (1/53)	0.00	1.000	64 (34/53)
	Control	9 (5/54)			6 (3/75)			2 (1/54)			89 (48/54)
PS Verbosity	Intervention	42 (22/53)	9.64	.001	27 (14/71)	7.61	.004	2 (1/53)	0.00	1.000	58 (31/53)
	Control	13 (7/54)			6 (3/77)			2 (1/54)			85 (46/54)
LBC Problem	Intervention	25 (13/53)	1.89	.139	8 (6/71)	0.54	.323	5 (3/53)	0.00	.673	70 (37/53)
	Control	13 (7/56)			4 (3/73)			3 (2/56)			86 (48/56)
LBC Confidence	Intervention	19 (10/53)	0.87	.284	7 (4/61)	0.00	1.000	2 (1/53)	0.00	1.000	79 (42/53)
	Control	11 (6/56)			6 (4/63)			4 (2/56)			86 (48/56)
CAPES Efficacy	Intervention	39 (19/49)	4.54	.026	-			4 (2/49)	0.00	.614	57 (28/49)
	Control	18 (9/51)						2 (1/51)			80 (41/51)

Note. T1 = time 1 (baseline); T4 = time 4 (12-month follow-up); BMI = body mass index; PS = Parenting Scale; LBC = Lifestyle Behaviour Checklist; CAPES = Child and Adjustment and Parent Efficacy Scale; ^aPearson's chi-square test for independence using Yates' Continuity Correction with 1 degree of freedom, 2-tailed *p* value for Fishers' Exact Test reported where expected frequency for any cell is <10. The CAPES Efficacy and LPQ Total have no recommended clinical cut-off, therefore clinical improvement was unable to be calculated.

Chapter 4

Kinder Overweight Activity Lifestyle Actions (KOALA) Healthy Lifestyle Program for children with obesity: A randomised controlled trial.

This chapter consists entirely of the following paper to be submitted to *International Journal of Obesity*:

Bartlett, J. A., Desha, L., Poulsen, A. A., Macdonald, D., Abbott, R., Mitchell, D., Dowdle, R., Gibbons, K., Sanders, M. R. & Leong, G. M. (2016). *Kinder Overweight Activity Lifestyle Actions (KOALA) Healthy Lifestyle Program for children with obesity: A randomised controlled trial*. Manuscript submitted for publication.

Abstract

Background: Evidence-based interventions to tackle the documented childhood obesity epidemic are urgently needed. The current study evaluated the effectiveness of the KOALA (Kinder Overweight Activity Lifestyle Actions) Mater Healthy Lifestyle Program.

Methods: A total of 97 overweight and obese children aged 6 to 12 years were randomly allocated to either the intervention or care as usual condition. The program combined care as usual with an intensive lifestyle parenting intervention (Group Lifestyle Triple P) and family camp (Scouts Active Camp) with dietetic consultations. Outcome assessment was conducted at baseline, 6-months and 12-months follow-up.

Results: Following the intervention, children showed significant improvements in body size, including reductions in weight *z*-score and body mass index *z*-score. A reduction in dysfunctional parenting styles was also observed, including PS Total, Overreactivity and Verbosity scores. Weight *z*-score improvements were maintained at 12-months follow-up.

Conclusions: These results suggest that the intervention had a greater effect than the care as usual condition on promoting the achievement of healthy weight 6-months following the intervention. This approach is recommended as an effective model in working with overweight or obese children.

Keywords: childhood obesity; treatment; parenting; Triple P; KOALA; family camp; randomised controlled trial.

Introduction

Childhood obesity is a major public health concern. In Australia, up to 25% of children are overweight or obese (Australian Bureau of Statistics, 2012). These children are at risk of developing serious comorbidities and psychological issues (Lobstein, Baur, & Uauy, 2004). The evidence suggests that the effects of childhood obesity continue into adolescence and adult life (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997), and can even result in premature death (Prospective Studies Collaboration, 2009). The public health costs associated with this epidemic are substantial and show a rapidly growing trend (Crowle & Turner, 2010). Policy makers are becoming increasingly aware of the statistics and many are calling for evidence-based interventions.

One single cause for the rise of obesity rates worldwide cannot be identified. A complex interplay of factors within the home and broader community environment appears more likely (Davison & Birch, 2001). Given the complex aetiology of childhood obesity, it is unlikely that one isolated intervention will lead to sustained population-wide effects. The World Health Organisation (2012) recommends an approach to childhood obesity that utilises evidence-based interventions within an integrated health care package.

One multidisciplinary program is the KOALA (Kinder Overweight Activity Lifestyle Actions) Mater Healthy Lifestyle Program. This intervention aimed to improve clinical practice and outcomes for children aged 6 to 12 years who were overweight or obese. It considers the role of factors beyond the individual child, and addresses wider socio-environmental factors. The program considers the risks and strengths of the individual child, family and wider community by incorporating a community-based family camp program (Scouts Active Camp) with an evidence-based parenting intervention (Group Lifestyle Triple P; West, Sanders, Cleghorn, & Davies, 2010) for overweight or obese children.

Childhood obesity interventions should include parents. Research demonstrates that interventions are more effective when parents are targeted as agents for change compared to child-only interventions (Golan, Weizman, Apter & Fainaru, 1998; Golan & Crow, 2004). Greater body size reductions are associated with interventions that combine parenting and nutrition/physical activity elements ($d = -0.64$), as opposed to programs that focus on diet or physical activity alone ($d = -0.02$; Reinehr, 2013). The efficacy of the Lifestyle Triple P program has been established in a number of randomised controlled trials (West, Sanders, Cleghorn, & Davies, 2010; Gerards et al., 2015). The Lifestyle Triple P program has never been evaluated when used in conjunction with conventional clinical obesity management.

Research evaluating health camps for overweight children is relatively sparse. Only five studies to date have evaluated camps, and none have been randomized controlled trials. Results to date are very promising in relation to child weight (Gately, Cooke, Barth, Bewick, Radley & Hill, 2005; Gately, Cooke, Butterly, Knight, & Carroll, 2000; Walker, Gately, Bewick, & Hill, 2003; Wong, Barlow, Mikhail, Wilson, Hernandez, Shypailo & Abrams, 2013). Health camps currently available for overweight children tend to be quite lengthy. Gately and colleagues (2005) reported that a mean camp duration of 29 days resulted in a weight loss of 6 kilograms. Family attendance at camp may produce additional benefits but has not been evaluated to date. Furthermore, the long-term effects of camp attendance on weight loss are less clear. The majority of research measures weight loss at camp completion with no long-term follow-up.

The present study evaluated for the first time the effectiveness of the KOALA Healthy Lifestyle Program, which combines a family camp with an evidence-based parenting program and dietetic consultations. Participants were randomly assigned to either a care as usual or intervention condition. The aim of this study was to demonstrate whether overweight or obese children participating in the KOALA intervention had better outcomes than those

receiving conventional clinical care alone. Serological data was also collected at baseline and 12-months follow-up.

Methods

Design

This study was a randomised controlled trial with a 2 (condition: intervention versus care as usual) by 3 (time: pre-intervention [Time 1], post-intervention at 6-months [Time 2], and 12-months follow-up [Time 3]) design. An overview of the flow of participants throughout the study is presented in Figure 8.

The primary delivery point was at the Mater Children's Hospital (South Brisbane, Australia), during 2007 to 2009. Ethical approval was received from both the Mater Health Services Human Research Ethics Committee (#HREC14MHS79) and The University of Queensland Medical Research Ethics Committee (#2007000728). A nominated parent or guardian provided participant consent, and the participating child provided assent.

Participants

Participants were recruited via word-of-mouth, schools, medical clinics, and general practices located within Brisbane, Australia. Inclusion criteria were as follows: (a) the child was aged 6-10 years; (b) at least one parent or guardian was willing to participate; and (c) the child's body mass index was greater than or equal to the 85th percentile-for-age according to Centre for Disease Control (CDC) criteria (Kuczmarski et al., 2000). Participants were ineligible if: (1) the child had hypertension, obstructive sleep apnoea, Type 2 Diabetes Mellitus, a genetic obesity-related syndrome, or orthopaedic complications of obesity; (2) the child was diagnosed with a neurodevelopmental disorder; (3) the child had emotional or behavioural problems; and (4) child had current or past history of taking medications known to affect weight or growth.

Participants were 97 parents who had a child aged 6-12 years (50% girls). On average, parents were aged 39.43 years ($SD = 5.72$) and their child 8.73 years ($SD = 1.50$). The majority of parents were mothers (84%), and 11% were fathers. A total of 49 (66%) of the parents were married. Most of the parents (86%) were Caucasian. Employed fathers (92%) worked an average of 34 hours a week ($SD = 18.72$), while employed mothers (61%) worked 26 hours ($SD = 13.43$). Most families had an annual income of either \$25,000AUD to \$75,000AUD, or \$75,000AUD to \$150,000AUD (47% and 41% in each income bracket, respectively). Table 5 shows demographic characteristics for the intervention and care as usual conditions.

Randomisation

Independent biostatisticians prepared the randomisation schedule using a sequentially numbered sealed opaque envelope system. Once participant consent was obtained, research staff opened the envelope and participants were informed of allocation. Stratified block randomisation was used according to age (2 groups: 6-8 years and 9-10 years) and child body mass index (2 groups: overweight [85th-95th percentile] and obese [$>95^{\text{th}}$ percentile]) to ensure an equal distribution between conditions.

Intervention

The multidisciplinary intervention consisted of three components: (1) Group Lifestyle Triple P Positive Parenting Program; (2) Scouts Active Camp; and (3) dietetic consultations. All intervention participants also received conventional care. The intervention was delivered to two cohorts given restrictions on the maximum number of parents able to attend programs at any one time. Allocation was determined by time at which participants were randomised.

Lifestyle Triple P

Lifestyle Triple P - Positive Parenting Program (West & Sanders, 2010) is an intensive, parent-only intervention for overweight or obese children aged 5 to 12 years. It targets

dysfunctional parenting styles associated with childhood obesity and builds parental self-efficacy in managing a child's lifestyle behaviour. It consisted of 16 sessions delivered over approximately 20 weeks, with 10 group sessions (2 hours each), and 6 individual telephone consultations (15-30 minutes each). Trained and accredited Triple P facilitators delivered the program using structured session checklists to ensure treatment fidelity. A total of 27 parents attended more than 75% of the parenting sessions, and 12 parents attended less than 75%.

Active Scouts Camp

Scouts Queensland, a community organisation, offered 3 overnight family camps to each cohort approximately 6 weeks apart (following baseline, 6 weeks and 3 months later) at Scouts Queensland facilities at Mount Cotton and Victoria Park, Brisbane. There was no cost to participants. The target child, nominated parent/s, and siblings were all invited to attend each camp, to minimize any stigma associated with the camps being only for overweight or obese children in the family. The camp consisted of outdoor physical activities and team building exercises typical of those run by Scouts Queensland, and included group adventure walks, canoeing, and ball and tag games. No nutrition education sessions were delivered; however, the Queensland Association of School Tuckshops reviewed the food menu to ensure it matched National Healthy Eating Guidelines (NHMRC, 2003b). A total of 17 (44%) families attended all 3 camps, 8 (21%) attended only 2 camps, 5 (13%) attended 1 camp, and 9 (23%) attended no camps.

Dietetic consultation

Four individualized consultations with a pediatric dietician were also provided at baseline, 1-, 2-, and 4-months. The consultations obtained information related to dietary intake of core food groups and recommended. Individualised meal plans were devised and issues relating to diet were problem-solved.

Care as usual condition

Participants in the care as usual condition attended assessment at baseline, 6- and 12-months follow-up. All participants had a consultation with the same paediatric endocrinologist (Dr. G. Leong) for a psychosocial and physical assessment. Nutrition, physical activity and behavioural strategies in accordance with National Health and Medical Research Council Australian guidelines for managing childhood obesity were also discussed (NHMRC, 2003a). Participants were encouraged to visit their general practitioner every two months between assessments. Participants were also given unrestricted access to a specifically developed website for the KOALA study, 'KOALA at Mater – Healthy Lifestyle Promotion, Education and Research Program', which included healthy tips and resources. Information sheets were also provided with healthy living tips, promoting lifestyle messages and engagement in physical and community activities.

Outcome measures

Demographic characteristics

The *Family Background Questionnaire* (FBQ; West & Sanders, 2010) collected demographic information about the family, parent and child.

Anthropometric measurements

Height was measured using a Seca 2200 stadiometer (Hamburg, Germany) within 0.1 cm, and weight was recorded on Digital Wheelchair Scales Model BS-110 within 0.1 kg. Children were barefoot and wore light clothing. Body mass index (BMI) and BMI z-scores were calculated using the United States Centre for Disease Control (CDC) 2000 child reference data (Kuczmarski et al., 2000). Waist measurements were taken to the nearest 0.1 cm using non-extensible steel tape (Seca 203, Hamburg, Germany). Measurements were taken at midpoint between the iliac crest and lower rib margin using umbilicus as a secondary

reference point. All measures were taken in accordance with standard procedures, as previously described by the World Health Organisation (2008).

Body composition

Bioelectrical impedance analysis (BIA; Body Stat© 1500MDD, Bodystat® Ltd, Douglas, UK) was used to assess body composition. Measurements were taken in the still supine position after initial rest period of 15 minutes as previously described by Cleary and colleagues (2008). A validated BIA equation of Schaefer and colleagues (1994) was used to calculate fat free mass (kilograms), percentage of fat mass (as a percentage of total body weight), and lean percent (as a percentage of total body weight).

Parenting

The *Parenting Scale* (PS; Arnold, O'Leary, Wolff, & Acker, 1993) is a 30-item measure of overall parenting style (PS Total), and three dysfunctional discipline styles: Laxness (permissive discipline), Overreactivity (displays of anger), and Verbosity (overly long reprimands). The PS had good internal consistency for Total $\alpha = .92$, Laxness $\alpha = .92$, and Overreactivity $\alpha = .88$, but poor for Verbosity $\alpha = .53$.

The *Lifestyle Behaviour Checklist* (LBC; West & Sanders, 2009) was used to assess parental confidence in dealing with 25 lifestyle-specific problem behaviours. Excellent internal consistency was found for the LBC Confidence scale ($\alpha = .95$).

Parental adjustment

The *Depression Anxiety and Stress Scale-21* (DASS-21; Lovibond & Lovibond, 1995) is a brief measure, which assesses psychological distress, including symptoms of depression, anxiety and stress. The internal consistencies of the scales were high (Depression $\alpha = .88$, Anxiety $\alpha = .76$, and Stress $\alpha = .87$).

Parent relations

The *Relationship Quality Index* (RQI; Norton, 1983) is a 6-item measure assessing relationship quality and satisfaction. Internal consistency was excellent ($\alpha = .93$).

The Parent Problem Checklist (PPC; Dadds & Powell, 1991) assesses inter-parental conflict over childrearing. The PPC Extent scale rates the degree of disagreement over rules and discipline. Internal consistency with the current sample was high ($\alpha = .88$).

Child behaviour

The LBC Problem scale was used to assess child lifestyle-specific problem behaviours. Parents rate the extent to which they experience the behaviours listed. Good internal consistency was observed ($\alpha = .89$).

The *Strengths and Difficulties Questionnaire* (SDQ; Goodman, 1997) is a brief questionnaire listing 25 attributes in children. Parents rate the extent to which each attribute applies to their child. The Emotional Problems and Prosocial subscales were used to assess emotional problems and social functioning. However, due to unacceptable internal consistency in this sample the subscales were not included in analyses (Emotional $\alpha = .32$ and Prosocial Behaviour $\alpha = .38$).

Serological data

Blood samples were collected after 12 hours of fasting at baseline and 12-months follow-up. These tests were performed in an accredited laboratory (Mater Pathology, South Brisbane, Australia). Total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and triglycerides (TG) levels were obtained and homeostatic model insulin resistance assessment (HOMA-IR) based on fasting glucose (mmol/L) x fasting insulin (uU/ml) divided by 22.5 (Matthews, Hosker, Rudenski, Naylor, Treacher, & Turner, 1985).

Procedure

Parents contacted research staff to discuss potential participation and complete eligibility screening via telephone. The parent and target child attended the Mater Children's Hospital KOALA Health and Wellness Clinic for anthropometric measurements, body composition assessment and questionnaire completion. Trained staff conducted all measurements using standard procedures (WHO, 2008). Prior to the visit, participants attended Mater Pathology for specimen collection. Participants were then given a sealed allocation envelope to open, and thus informed of allocation.

Participants assigned to the intervention condition attended the next available intervention, following which they completed the range of assessment tasks again at 6-months (Time 2) and 12-months (Time 3). Participants assigned to the CAU condition completed the same assessment process at 6- and 12-months following baseline assessment.

Results

Statistical analyses

Analyses were performed using SPSS 23.0 (SPSS Inc, Chicago, IL). A series of repeated-measures multivariate and univariate analyses of covariance were conducted to evaluate the short-term intervention and maintenance effects. MANCOVAs were performed on each set of conceptually related dependent variables at Time 2 and Time 3. *Condition* (2 groups: intervention versus CAU) was a between-groups independent variable, and Time 1 scores were included as covariates. MANCOVAs consisted of the following: child anthropometric measurements (weight *z*-score, BMI *z*-score, and waist circumference), body composition (fat mass, fat weight, and lean percent), parenting (PS Total, Overreactivity, Verbosity, Laxness and LBC Confidence), parental adjustment (DASS depression, stress, and anxiety), parent relations (RQI and PPC Extent scale) and serological data (cholesterol, HOMA, HDL, LDL, and TG). If significant multivariate effects were found, ANCOVAs were then conducted and

univariate F values examined to determine the variables that contributed to the multivariate effect. Multivariate analyses were not conducted on the LBC Problem scale as it was not expected to correlate with other outcome variables, and thus an ANCOVA was used.

There was 42% of missing total value outcome scores in the overall data set from Time 1 to Time 3 (with 46% and 39% in the intervention and CAU, respectively). The proportion of participants who were lost to follow-up over the course of the study did not differ significantly between intervention (28/47) and CAU conditions (26/48), $\chi^2(1, n = 97) = 0.70$, $p = .792$. Although 97 participants were randomized to condition, 17 participants lacked data at Time 1 and were not included in analyses. All analyses were performed in line with the intention-to-treat principle such that all participants who completed baseline assessment were included in the analyses ($n = 78$). Multiple imputation techniques were employed to impute missing values (Rubin, 2008). This technique is recommended above traditional methods of case deletion and mean substitution for dealing with missing data (Schafer, 2002).

The Markov Chain Monte Carlo (MCMC) algorithm with 100 iterations was used to produce five multiple data sets using Predictive Means Matching (PMM), with baseline scores entered as auxiliary variables in the PMM model. Statistical analyses were then performed on each imputed data set, and the pooled ANCOVA results were obtained using the procedure recommended by van Ginkel and Kroonenberg (2014), including the SPSS syntax to adjust the degrees of freedom of the combined ANCOVA results and t -tests (van Ginkel, 2014; van Ginkel, 2008).

Effect sizes of the post intervention and maintenance effects were calculated from the mean pre-post change in the intervention group minus the pre-post change in each data set in the CAU condition divided by the pooled baseline standard deviation (Morris, 2008). The effect sizes for Time 3 were calculated using the same method, however the mean pre-

intervention to Time 3 change was used in the calculations. Effect sizes were interpreted as: small (≥ 0.2), medium (≥ 0.5) and large (≥ 0.8) (Cohen, 1992).

Preliminary analyses

Preliminary analyses revealed no significant differences between the intervention and CAU conditions on demographic characteristics (Table 5). Analyses were also conducted on all outcome variables at baseline (means and standard deviations are presented in Table 2). A significant difference was found for fat mass, showing less fat mass for children in the intervention condition compared to CAU, $t(63) = 2.18, p = .033$.

Short-term intervention effects

Short-term intervention effects, means, standard deviations and effect sizes are presented in Table 6.

Anthropometric measurements

The multivariate analyses revealed a significant condition effect on the child anthropometric measurements, $F(3, 71) = 3.43\text{--}6.86, p = .000\text{--}.021$. Univariate tests revealed a significant condition effect for weight z -scores, $F(1, 31) = 14.03, p = .001$, and BMI z -scores, $F(1, 30) = 10.52, p = .003$. Small effect sizes were found ($d = .21$ for weight z -scores and $d = .28$ for BMI z -scores). At post-intervention children in the intervention condition had significantly lower weight z -scores and BMI z -scores than children in the CAU condition. No significant condition effects were found for waist circumference.

Body composition

Analysis of fat mass, fat weight, and lean percent, revealed a significant multivariate condition effect, $F(3, 71) = 1.25\text{--}5.68, p = .002\text{--}.299$. Univariate effects were explored, as p -values for the MANCOVA ranged from significant to non-significant results, and thus results were unclear without further analyses being conducted. Univariate tests revealed a significant effect of condition for fat mass, $F(1, 20) = 5.47, p = .030$, with a small effect size ($d = .24$).

Children in the CAU group showed a significantly greater increase in fat mass compared to intervention children, whose fat mass did not significantly change at Time 2. The condition effect for fat weight also approached significance, $F(1, 24) = 4.10, p = .054$, with the intervention condition showing a significant reduction in fat weight compared to no change in CAU. No significant condition effect was found for lean percent.

Parenting

A significant multivariate condition effect was found for parenting, $F(4, 68) = 1.88-3.41, p = .013-.125$. Univariate analyses revealed significant univariate intervention effects for PS Total, Verbosity and Overreactivity, ($F(1, 59) = 9.41, p = .003, F(1, 34) = 5.49, p = .025, F(1, 57) = 4.32, p = .042$, respectively). All effect sizes were medium ($d = .76, d = .59$, and $d = .33$ for PS Total, Verbosity and Overreactivity, respectively). At post-intervention, parents in the intervention group had significantly lower PS Total, Verbosity and Overreactivity scores than the CAU condition. The main effects of condition for LBC Confidence and Laxness scores were not significant.

Parental adjustment

A MANCOVA of parental adjustment revealed no significant multivariate effect of condition, $F(3, 71) = 0.58-1.17, p = .326-.628$.

Parent relations

A MANCOVA of parent relations revealed no significant main effect of condition, $F(2, 73) = 0.18-1.43, p = .246-.835$.

Child behaviour

Univariate analyses of the LBC Problem scale revealed a significant main effect of condition, $F(1, 71) = 4.29, p = .042$. Children in the intervention condition had significantly lower lifestyle problem scores than those in the CAU condition. The effect size was small ($d = .14$).

Maintenance of intervention effects

Anthropometric measurements

A significant MANCOVA condition effect was found on the child anthropometric measurements at 12-months follow-up, $F(3, 71) = 3.02\text{--}6.19$, $p = .001\text{--}.035$. Univariate tests showed a significant main effect of condition on weight z-scores, $F(1, 54) = 8.50$, $p = .005$. Children in the intervention condition had significantly lower weight z-scores at 12-months following the intervention compared to CAU children. The main effect of condition for BMI z-score approached significance, $F(1, 40) = 3.94$, $p = .054$. No condition effect occurred for waist circumference.

Body composition

A significant MANCOVA condition effect was found on body composition at 12-months follow-up, $F(3, 71) = 0.67\text{--}3.32$, $p = .025\text{--}.573$. However, follow-up univariate tests revealed no significant main effects of condition on fat weight, fat mass, or lean percent.

Parental adjustment

A MANCOVA of parental adjustment found no significant main effect of condition, $F(3, 71) = 0.32\text{--}0.71$, $p = .548\text{--}.808$.

Parent relations

A MANCOVA of parent relations revealed a significant main effect of condition, $F(2, 73) = 0.25\text{--}4.16$, $p = .019\text{--}.781$. However, follow-up contrasts revealed that the univariate condition effect for RQI and PPC Intensity were not significant, $F(1, 21) = 1.61$, $p = .219$, and $F(1, 42) = 0.02$, $p = .880$, respectively.

Child behaviour

No significant univariate effect of condition was found on LBC Problem scores at 12-months following the intervention, $F(1, 65) = 1.35$, $p = .250$.

Serological data

A MANCOVA of the serological data revealed no significant main effect of condition, $F(5, 40) = 2.02-2.12, p = .083-.097$.

Discussion

This study demonstrated that a multidisciplinary intervention involving a family camp, evidenced-based parenting program and dietetic advice with conventional care was superior to conventional care alone at 6-months post-intervention. The intervention group showed significantly greater improvements than the care as usual condition in child body size parameters (including weight *z*-scores and BMI *z*-scores), parenting styles, and child lifestyle behaviour at 6-months post-intervention. Improvements in weight *z*-scores were maintained at 12-months follow-up, and BMI *z*-scores approached significance. Furthermore, the percentage of fat mass was significantly greater in the CAU condition at 6-months, compared to no change in the intervention group. These results suggest that the KOALA program had a greater effect than conventional care on promoting the achievement of healthier weight and body composition, child behaviour and parenting practices.

The current intervention showed a reduction in mean BMI *z*-score of -0.19 at 6-months, with maintenance of BMI effects with a *z*-score change of only -0.01 at 12-months. It is difficult to compare these study results with other research given the multidimensional nature of the program. Previous evaluations of the Triple P program have revealed comparable BMI *z*-score reductions at 6-months (West, Sanders, Cleghorn, & Davies, 2010). A Cochrane meta-analysis found a mean difference in BMI *z*-score of -0.06 at 6 months, and -0.04 at 12-months follow-up for lifestyle interventions in children younger than 12 years (Oude Luttikuis et al., 2009).

Research suggests that reductions in adiposity are associated with lowering risk for the development of obesity-associated disease such as cardiovascular disease and diabetes

mellitus (Guh, Zhang, Bansback, Amarsi, Birmingham, & Anis, 2009). It should be noted that the changes detected in body parameters at 6-months were not matched by a change in serological markers at the 12-month assessment. As no 6-month serological markers were obtained, the possibility that some of these markers had improved at 6-months and reverted to their former levels cannot be excluded.

The study findings give new insights into the effectiveness of multidimensional interventions. In addition to improvements in body size parameters, such interventions have the capacity to improve parenting skills and child lifestyle behaviour, including excessive eating and television viewing. It should be noted that the parenting and child outcomes were not maintained at 12-months follow-up, which may be related to the intervention dosage. Camp and parent program attendance was lower than expected. Given that the weekend camps were only overnight and that only 44% of all families attended all 3 camps while 56% of families only attended 0, 1, or 2 camps, the demonstrated improvements at 6-months are substantial. Many other camp structures from previous literature were 28 days in length. Furthermore, focus-group research on parental experience of the Active Scouts Camp suggests that families considered the camp a positive experience (Smibert, Abbott, Macdonald, Hogan, & Leong, 2010). The current study results and focus group feedback suggest a shorter duration and whole-of-family camp combined with Lifestyle Triple P may be an effective intervention for childhood obesity to improve health behaviours and body weight and composition.

Due to the multidimensional nature of the KOALA intervention, the relative impact of participating in the parenting program, active camps and dietetics consultations could not be established. A limitation of the current study was that no attendance data for the dietetic consultations were collected. It is important that further evaluations collect attendance data from each component of the intervention to ascertain the relative impact of each. Furthermore,

each of the components of the intervention are resource intensive, it is an imperative for future research to ascertain the most effective and economically sustainable combination of components to incorporate into family interventions, and the extent of family participation required for improvements.

Recruiting families into the study proved to be quite difficult and took longer than anticipated. Engaging parents in this process is likely to be facilitated by a universal seminar series and public awareness campaign. Furthermore, as the study required an intensive time commitment from participants to complete assessment the attrition rate of participants was quite high. The limited sample size and high levels of missing data adds to the uncertainty in intervention effect estimates and may be a possible reason for a lack of maintenance of intervention effects at 12-months follow-up. Future evaluations of the KOALA program should focus on identifying specific barriers and enablers to attendance and developing strategies to address participation rates. Examples may involve offering incentives for participation and including protocols for data collection (e.g., phone call reminders for assessments and establishing researcher steps taken if survey data is not completed to ensure data is completed). Another study limitation was the lack of outcome data assessing physical activity and nutrition. These outcomes are important determinants of child obesity development, and should be included in future evaluations of the intervention (e.g., assessing food intake using a food diary and child physical activity using accelerometers).

Conclusions

This study highlights the importance of a multidisciplinary approach to the management of childhood obesity. It demonstrates that improved outcomes can be achieved by combining different disciplines. Significant improvements may be gained by augmenting conventional care as usual with a family camp, parenting program and dietetic consultations. Positive outcomes were demonstrated in relation to child body measurements, child lifestyle

behaviour and parenting. A multidisciplinary approach offers an advantage to those attempting to treat childhood obesity.

References

- Arnold, D. S., O'Leary, S. G., Wolff, L. S., & Acker, M. M. (1993). The Parenting Scale: A measure of dysfunctional parenting in discipline situations. *Psychological Assessment*, 5, 137–144. doi: 10.1037/1040-3590.5.2.137
- Australian Bureau of Statistics. (2012). *Australian Health Survey: updated results, 2011–2012*. (No. 4364.0.55.001). Canberra, ACT: Commonwealth of Australia.
- Cleary, J., Daniells, S., Okely, A., Batterham, M., & Nicholls, J. (2008). Predictive validity of four bioelectrical impedance equations in determining percent fat mass in overweight and obese children. *Journal of American Dietetics Association*, 108, 136-139. doi: 10.1016/j.jada.2007.10.004
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112, 155–159.
- Crowle, J. & Turner, E. (2010). *Childhood obesity: An economic perspective*. Productivity Commission Staff Working Paper, Melbourne. Retrieved from <http://www.pc.gov.au/research/supporting/childhood-obesity/childhood-obesity.pdf>
- Dadds, M. R., & Powell, M. B. (1991). The relationship of interparental conflict and global marital adjustment to aggression, anxiety, and immaturity in aggressive and nonclinic children. *Journal of Abnormal Child Psychology*, 19, 553-567.
- Davison, K. K., & Birch, L. L. (2001). Childhood overweight: A contextual model and recommendations for future research. *Obesity Reviews*, 2, 159-171. doi: 10.1046/j.1467-789x.2001.00036.x
- Gately, P. J., Cooke, C. B., Barth, J. H., Bewick, B. M., Radley, D., & Hill, A. J. (2005). Children's residential weight-loss programs can work: A prospective cohort study of short-term outcomes for overweight and obese children. *Pediatrics*, 116, 73-77. doi: 10.1542/peds.2004-0397

- Gately, P. J., Cooke, C. B., Butterly, R. J., Knight, C., & Carroll, S. (2000). The acute effects of an eight-week diet, exercise and educational camp program on obese children. *Pediatric Exercise Science*, 12, 413-423.
- Gerards, S. M. P. L., Dagnelie, P. C., Gubbels, J. S., Van Buuren, S., Hamers, F. J. M., Jansen, M. W. J., ... Kremers, S. P. J. (2015). The effectiveness of Lifestyle Triple P in the Netherlands: A randomized controlled trial. *Plos One*, 10, 1-18. doi: 10.1371/journal.pone.0122240
- Golan, M., & Crow, S. (2004). Targeting parents exclusively in the treatment of childhood obesity: long-term results. *Obesity Research*, 12, 357-361. doi: 10.1038/oby.2004.45
- Golan, M., Weizman, A., Apter, A., & Fainaru, M. (1998). Parents as the exclusive agents of change in the treatment of childhood obesity. *The American Society for Clinical Nutrition*, 67, 1130-1135.
- Goodman, R. (1997). The Strengths and Difficulties Questionnaire: A research note. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 38(5), 581-586.
- Guh, D. P., Zhang, W., Bansback, N., Amarsi, Z., Birmingham, C.L., & Anis, A. H. (2009). The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. *BMC Public Health*, 9, 88. doi: 10.1186/1471-2458-9-88
- Kuczmarski, R. J., Ogden, C. L., Grummer-Strawn, L. M., Flegal, K. M., Guo, S. S., ... Johnson, C. L. (2000). CDC growth charts: United States. Hyattsville, MD: National Center for Health Statistics.
- Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: A crisis in public health. *Obesity Review*, 5, 4-104. doi: 10.1111/j.1467-789X.2004.00133.x
- Lovibond, S. H., & Lovibond, P. F. (1995). *Manual for the Depression Anxiety Stress Scales* (2nd ed.). Sydney, NSW: Psychology Foundation of Australia.

- Oude Luttikhuis, H., Baur, L., Jansen, H., Shrewsbury, V. A., O'Malley, C., Stolk, R. P., & Summerbell, C. D. (2009). Interventions for treating obesity in children (review). *Evidence-Based Child Health: A Cochrane Review Journal*, 4, 1571-1729. doi: 10.1002/14651858.CD001872.pub2
- Matthews, D. R., Hosker, J. P., Rudenski, A. S., Naylor, B. A., Treacher, D. F., & Turner, R. C. (1985). Homeostasis model assessment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. *Diabetologia*, 28, 412-419.
- Morris, S. B. (2008). Estimating effect sizes from pretest-posttest-control group designs. *Organ. Research Methods*, 11, 364-386.
- National Health and Medical Research Council. (2003a). *Clinical practice guidelines for the management of overweight and obesity in children and adolescents*. Canberra, ACT: National Health and Medical Research Council.
- National Health and Medical Research Council. (2003b) *Dietary Guidelines for Children and Adolescents in Australia incorporating the Infant Feeding Guidelines for Health Workers*. Canberra, ACT: National Health and Medical Research Council.
- Norton, R. (1983). Measuring marital quality: A critical look at the dependent variable. *Journal of Marriage and the Family*, 45, 141-151.
- Reinehr, T. (2013). Lifestyle intervention in childhood obesity: Changes and challenges. *Nature Reviews Endocrinology*, 9, 607-614. doi: 10.1038/nrendo.20213.149
- Rubin, D. B. (2008). *Multiple imputation for nonresponse in surveys*. New York, NY: John Wiley & Sons, Inc.
- Schafer, J. L., Georgi, A., Zieger, A., & Scharer, K. (1994). Usefulness of bioelectric impedance and skinfold measurements in predicting fat-free mass derived from total body potassium in children. *Pediatric Research*, 35, 617-624.

- Schafer, J. L., Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods*, 7, 147-177.
- Smibert, A., Abbott, R., Macdonald, D., Hogan, A., & Leong, G. (2010). School, community, and family working together to address childhood obesity: Perceptions from the KOALA lifestyle intervention study. *European Physical Education Review*, 16, 155-170. doi: 10.1177/1356336X10381307
- van Ginkel J. R., & Kroonenberg, P. M. (2014). Analysis of variance of multiply imputed data. *Behavioural Research*, 49, 78-91.
- van Ginkel, J. R. (2008). *SPSS syntax for applying rules for combining univariate estimates in multiple imputation*. Available from: <http://socialsciences.leiden.edu/educationandchildstudies/childandfamilystudies/organisation/staffcfs/van-ginkel.html>
- van Ginkel, J. R. (2014). *SPSS syntax for applying rules for combining multivariate estimates in multiple imputation*. Available from: <http://socialsciences.leiden.edu/educationandchildstudies/childandfamilystudies/organisation/staffcfs/van-ginkel.html>
- West, F. & Sanders, M. R. (2009). The Lifestyle Behaviour Checklist: A measure of weight-related problem behaviour in obese children. *Journal of Pediatric Obesity*, 4, 266-273. doi: 10.3109/17477160902811199
- West, F. & Sanders, M. R. (2010). *Facilitator's manual for Group Lifestyle Triple P*. Brisbane, QLD: Triple P International.
- West, F., Sanders, M. R., Cleghorn, G. J., & Davies, P. S. (2010). Randomised clinical trial of a family-based lifestyle intervention for childhood obesity involving parents as the exclusive agents of change. *Behaviour Research & Therapy*, 48, 1170-1179. doi: 10.1016/j.brat.2010.08.008

- Whitaker, R. C., Wright, J. A., Pepe, M. S., Seidel, K. D., & Dietz, W. H. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *New England Journal of Medicine*, 337, 869-873. doi: 10.1056/NEJM199709253371301
- Wong, W. W., Barlow, S. E., Mikhail, C., Wilson, T. A., Hernandez, P. M., Shypailo, R. J., & Abrams, S. H. (2013). A residential summer camp can reduce body fat and improve health-related quality of life in obese children. *Journal of Paediatric Gastroenterology Nutrition*, 56, 83-85. doi: 10.1097/MPG.0b013e3182736f70
- World Health Organisation (2008). *WHO Stepwise approach to surveillance (STEPS)*. Geneva, Switzerland: World Health Organization.
- World Health Organisation. (2012). *Population-based approaches to childhood obesity prevention*. Geneva, Switzerland: World Health Organisation.

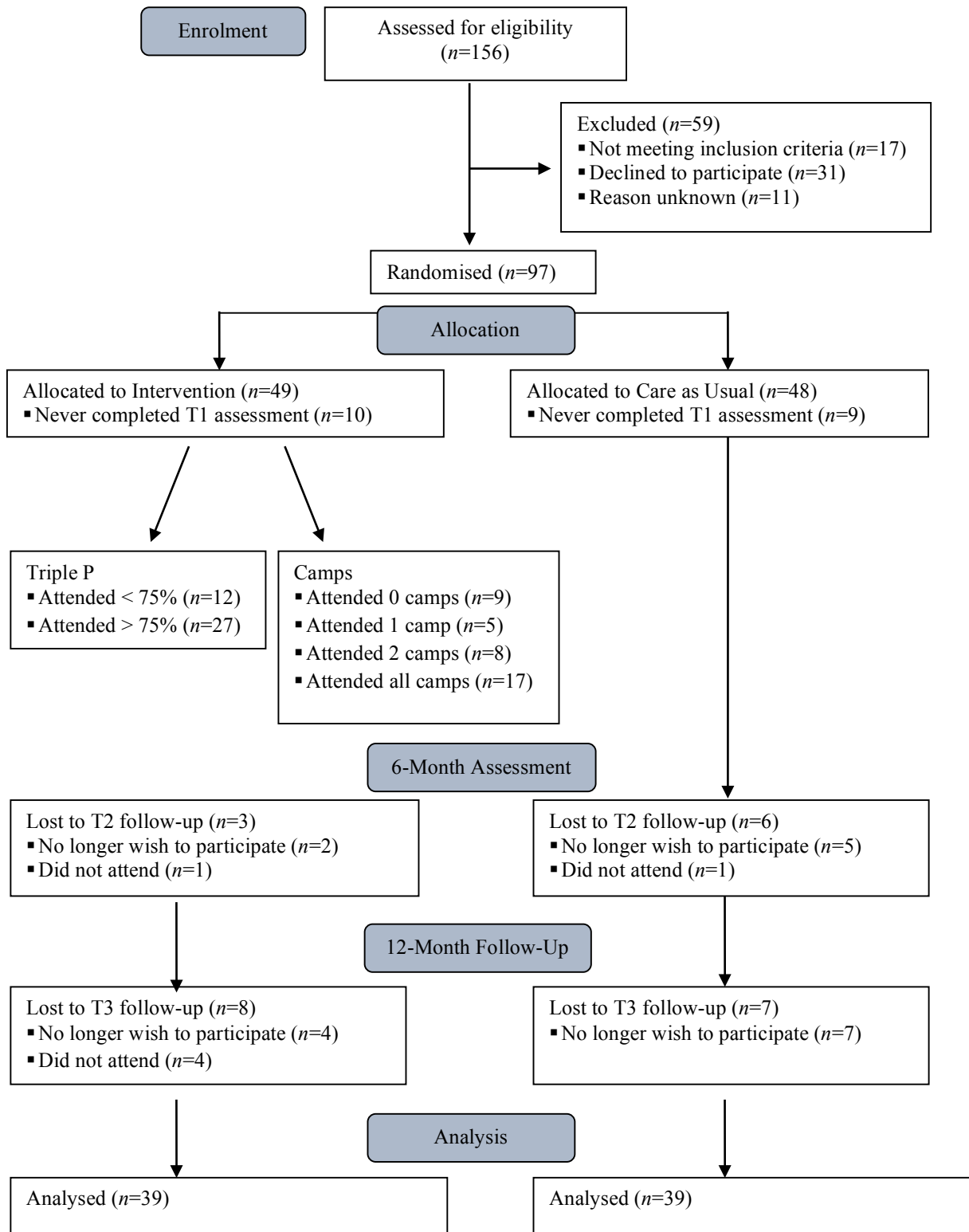


Figure 8. CONSORT diagram of the flow of participants.

Table 5.
Demographic characteristics of the sample by condition.

Variable	Intervention (<i>n</i> = 39)		Care As Usual (<i>n</i> = 39)		Difference between the conditions	
Continuous	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Child's age (years)	8.76	1.56	8.94	1.37	0.56	.580
Parent's (years)	39.33	6.12	39.67	5.42	0.23	.817
Mother's paid work (hr/week)	26.62	11.14	24.73	14.54	-0.54	.552
Father's paid work (hr/week)	36.17	19.22	31.16	18.62	-0.92	.364
Child waist circumference (cm)	86.43	1.89	88.43	2.04	0.57	.574
Categorical	<i>n</i>	%	<i>n</i>	%	χ^2	<i>p</i>
Child's sex						
Male	20	51	18	46	0.21	.651
Female	19	49	21	54		
Parent Gender ^a						
Male	4	11	4	12	0.01	.932
Female	32	89	30	88		
Child's BMI range ^b						
Overweight	2	14	2	5	1.68	.195
Obese	24	86	37	95		
Household ^c						
Original biological	29	78	23	70	4.77	.092
One original, one step	0	0	4	12		
Sole parent	8	22	6	18		
Relationship status ^d						
Married/Defacto	28	74	27	79	0.33	.568
Separated/Divorced/Single	10	26	7	21		
Ethnic group ^e						
Caucasian	33	97	28	88	6.20	.185
Mediterranean	0	0	3	9		
Australian Torres Strait Islander	1	3	0	0		
Asian	0	0	1	3		
Mother's education						
High school or less	15	40	9	27	3.89	.143
Trade/college	7	18	13	40		
University degree	16	42	11	33		
Father's education						
High school or less	15	50	11	37	2.34	.311
Trade/College	10	33	9	30		
University degree	5	17	10	33		

Variable	Intervention (<i>n</i> = 39)		Care As Usual (<i>n</i> = 39)		Difference between the conditions	
Continuous	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Father employed						
No	1	4	2	7	1.33	.513
Yes	27	96	27	93		
Mother employed						
No	7	18	6	18	0.00	.979
Yes	31	82	27	82		
Annual income ^f						
<AUD\$25,000	2	5	1	3	1.64	.650
AUD\$25,000 – 75,000	16	42	14	45		
AUD\$75,000 – \$150,000	18	48	12	39		
>AUD\$150,000	2	5	4	13		

^aData missing for 3 intervention cases and 5 CAU cases; ^bData missing for 13 intervention cases; ^cData missing for 2 intervention cases and 6 CAU cases; ^dData missing for 1 intervention case and 5 CAU cases; ^eData missing for 5 intervention cases and 8 CAU cases; ^fData missing for 1 intervention case and 8 CAU cases; CAU = Care As Usual; BMI = Body Mass Index; AUD = Australian Dollars.

Table 6. Intervention effects for the intervention and care as usual conditions at pre-intervention, post-intervention and 12-months follow-up.

Measure	Intervention (<i>n</i> = 39)						Care As Usual (<i>n</i> = 39)						ANCOVA: main effect of condition at Time 2 ^a			Effect size T1-T2 ^b	
	PRE		T2		T3		PRE		T2		T3		<i>F</i>	<i>df</i>	<i>p</i>	<i>d</i>	<i>95%CI</i>
Weight <i>z</i> -score	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>					
Weight <i>z</i> -score	2.26	0.10	2.06	0.09	2.06	0.08	2.45	0.09	2.41	0.91	2.40	0.09	14.30	(1, 31)	.001***	0.21	-0.22–0.64
BMI <i>z</i> -score	2.19	0.07	2.00	0.07	2.01	0.06	2.31	0.09	2.24	0.06	2.21	0.07	10.52	(1, 30)	.003**	0.28	-0.17–0.73
Waist (cm)	90.00	1.69	89.33	2.32	90.26	2.50	85.56	1.58	85.66	1.91	88.50	2.56	0.03	(1, 14)	.859	<i>ns</i>	
Fat mass (%)	20.71	1.13	20.32	1.16	21.70	1.32	25.52	1.32	27.06	1.42	28.21	1.50	5.47	(1, 20)	.030*	0.24	-0.20–0.68
Fat weight (kg)	18.13	0.80	17.25	0.95	18.01	1.17	21.60	1.03	22.20	1.07	22.54	1.39	4.10	(1, 24)	.054	<i>ns</i>	
Lean (%)	31.80	1.19	32.41	2.47	37.63	1.49	28.17	1.16	31.38	2.69	33.20	1.42	0.02	(1, 60)	.886	<i>ns</i>	
PS Total	3.32	0.11	2.75	0.08	3.07	0.09	3.17	0.12	3.01	0.07	3.14	0.10	9.41	(1, 59)	.003**	0.76	0.28–1.23
Verbosity	3.94	0.11	3.33	0.14	3.49	0.16	3.80	0.15	3.63	0.10	3.60	0.13	5.49	(1, 34)	.025*	0.59	0.09–1.09
Overreactivity	3.25	0.14	2.68	0.11	2.99	0.10	3.14	0.15	2.94	0.10	3.01	0.07	4.43	(1, 57)	.042*	0.33	-0.10–0.76
Laxness	2.83	0.18	2.66	0.11	2.92	0.11	2.93	0.15	2.42	0.11	2.82	0.11	0.34	(1, 71)	.562	<i>ns</i>	
LBC Problem	73.83	3.49	66.53	2.99	66.62	2.51	80.65	3.58	76.46	2.90	71.84	2.93	4.29	(1, 71)	.042*	0.14	-0.31–0.59
Confidence	166.89	5.62	181.89	4.27	190.51	2.92	162.52	6.11	177.11	5.09	178.13	5.04	4.43	(1, 65)	.069	<i>ns</i>	
DASS Total	11.78	1.63	10.34	1.34	10.72	1.02	12.34	1.46	11.86	1.43	10.81	1.55	0.52	(1, 14)	.482	<i>ns</i>	
Anxiety	1.16	0.26	1.07	0.35	1.31	0.33	1.11	0.22	1.57	0.38	1.40	0.42	1.79	(1, 16)	.199	<i>ns</i>	
Stress	3.06	0.38	2.39	0.35	2.61	0.33	3.19	0.33	2.31	0.37	2.50	0.26	0.04	(1, 68)	.834	<i>ns</i>	
Depression	1.66	0.32	1.73	0.48	1.45	0.38	1.87	0.33	1.51	0.34	1.51	0.34	0.13	(1, 8)	.728	<i>ns</i>	
RQI	32.84	1.54	29.50	2.64	33.88	1.72	30.67	1.50	29.63	1.50	30.77	1.74	0.19	(1, 9)	.677	<i>ns</i>	
PPC Extent	37.52	2.15	30.92	0.81	36.28	2.64	42.26	2.63	30.99	1.12	36.53	1.19	0.24	(1, 9)	.639	<i>ns</i>	

Note. PRE, T2, T3 = pre- and post-intervention and follow-up outcomes consisting of pooled *M* and *SE* values from multiple imputation data sets; ^aPooled ANCOVA results for the condition effect computed from multiple imputation data sets; ^bCohen's *d* for pre-post-test control group designs; 95% CI = 95% confidence intervals of effect sizes; LBC = Lifestyle Behaviour Checklist; PS = Parenting Scale, BMI = Body Mass Index; RQI = Relationship Quality Index; DASS = Depression, Anxiety Stress Scale; PPC = Parent Problem Checklist; PRE = pre-intervention; T2 = Time 2 (6-months); T3 = Time 3 (12-months); **p* < .05, ***p* < .01, ****p* < .001.

Chapter 5

General Discussion and Conclusions

Summary

The research presented in this thesis focused on the Lifestyle Triple P multilevel system of parenting and family support, which blends a targeted intervention for overweight or obese children with a universal healthy living seminar series for all parents regardless of child weight to facilitate population-level changes. A series of studies were conducted to evaluate the effectiveness of the Level 2 seminar and Level 5 intensive interventions independently. This chapter will summarise the findings and provide suggestions for future research, clinical practice, and obesity-specific policy initiatives.

Major conclusions

Lifestyle Triple P multilevel population approach

Chapter 1 proposed a population health approach to lifestyle parenting support. The relationship between parenting style and child lifestyle behaviour was outlined, and the benefits of parenting interventions made evident. The Lifestyle Triple P 3-level parenting support strategy was proposed to integrate with the broader Triple P principles. The 3 levels include a media and communication campaign, a universal healthy living seminar series, and an intensive targeted intervention for parents of overweight and obese children. The existing research base was discussed in relation to the intensive intervention (Level 5) to demonstrate the effectiveness of this program on child body size, and parent and child outcomes. The effectiveness of the Level 2 seminar series was also discussed, highlighting improvements in lifestyle behaviour for the child, parenting practices, and parental confidence. A large-scale trial is needed to evaluate the effectiveness of this suite of interventions on child and parent outcomes at the population-level. Future research should investigate the effectiveness of the Level 1 media and communication strategy (e.g., television, radio, online and print media) on positive parenting and child lifestyle behaviour. Future research should also assess the cost effectiveness of this public health approach to childhood obesity to ensure financial viability.

RCT of the Lifestyle Triple P Seminar Series

This randomized controlled trial evaluated the efficacy of the new Lifestyle Triple P Seminar Series. A total of 160 parents of children from all weight status between 3 to 10 years were included, and families were randomly allocated to the intervention or control condition. Parents were assessed on a range of child and parent outcomes, including lifestyle-specific and general child and parent behaviour, nutrition and physical activity. Assessment was conducted at pre-intervention, post-intervention, 6-months and 12-months follow-up.

Following the intervention, there was a reduction in child lifestyle problem behaviour and dysfunctional parenting styles. Parental confidence in managing lifestyle-specific and general child behaviour improved. The results support the efficacy of the intervention. As this program is substantially shorter than most prevention programs previously described it may provide much improved cost benefit, increase parental engagement in lifestyle interventions, and improve parental reach through delivery on a universal scale. Program delivery was via a single practitioner within a research context. Independent evaluators should conduct replication studies.

RCT of the KOALA Healthy Lifestyle Program for children with obesity

This study evaluated the efficacy of the KOALA Healthy Lifestyle program, which combined Group Lifestyle Triple P (Level 5 intervention) with three, overnight Active Scouts Camps and dietetic consultations in a group of 97 parents of overweight and obese children 5 to 12 years. Families were randomly allocated to the intervention or care as usual conditions. Parents were assessed on a range of child and parent outcomes, including lifestyle-specific and general child and parent outcomes, at baseline, 6-months and 12-months follow-up. A series of serological tests were performed at pre-intervention and 12 months. Significant improvements in child body size were found at 6 months, including significant reductions in BMI z-scores and weight z-scores. Dysfunctional parenting styles improved following the

intervention. Weight z-score improvements were maintained at 12-months follow-up. Whilst findings suggest that the intervention plus conventional care is superior to conventional care alone at 6-months following the intervention, future research should focus on evaluating the individual treatment components and their relative contribution to intervention effects. Further evaluations should also include assessment of child nutrition and physical activity outcomes.

Limitations of the current program of research

Socioeconomic status and cultural diversity

One of the limitations in this research relates to its ability to generalise to other cultures and socioeconomic groups. Despite specifically targeting geographic areas with a higher concentration of lower socio-economic households (i.e., offering assessments and parenting sessions in Ipswich), the large majority of families evaluated were of Australian descent and high socioeconomic status. Given that obesity is associated with lower socioeconomic status and some ethnic minorities (Hardy, King, Espinel, Cosgrove & Bauman, 2010; Vereecken, Keukelier, & Maes, 2004), it may be difficult to extrapolate the results of this study to the general population, and more importantly to the groups that are most at-risk of obesity. From a population health perspective, it is important that particular efforts are made to engage these at-risk groups.

Future research should assess the effectiveness of the intervention using RCT design with a sample of parents from low-income brackets and/or different cultural contexts. Further research could also investigate the attitudes and cognitions towards lifestyle habits and motivating factors for attendance at lifestyle-specific parenting programs in these at-risk populations. Furthermore, disadvantaged families may require additional interventions beyond lifestyle-specific support (e.g., strengthening mother-child attachment or

psychosocial support to vulnerable caregivers), and from a policy perspective the Lifestyle Triple P program may be delivered as part of a package alongside these other inputs.

Cross-cultural delivery of this program may be challenging given the diversity in food items and nutritional guidelines in different countries. As described in Chapter 2, this will require tailoring the program through close consultation with the local workforce followed by independent evaluation.

Outcome measure selection

The psychometric property of the Lifestyle Parenting Questionnaire, which was used as an outcome variable in the Lifestyle Seminar Series RCT (Chapter 3), has not yet been established. Future research should determine its factor structure, test-retest reliability, and validity for future use with lifestyle intervention evaluation trials.

A limitation of the KOALA RCT (Chapter 4) was the lack of outcome data for child screen-time behaviour. Given the importance of screen-time behaviour to the development of weight issues in children (as outlined in Chapter 1), this outcome variable should be included in future evaluations. Screen-time behaviour could be assessed via parental self-report of total time spent using the screen for entertainment, a 24-hour time use diary completed by parents, or using a specific measure of screen time for children (e.g., Children's Leisure Activities Survey [CLASS]; Telford, Salmon, Jolley, & Crawford, 2004).

Long-term follow-up assessments

Both RCTs conducted had a 12-month follow-up, however evaluation over a longer period of 2-, 5- and 10-years should be conducted.

Future recommendations for researchers

Father involvement

There is emerging evidence for a relationship between the father's parenting practices and child feeding styles with the child's eating behaviour and weight status (Fraser, Skouteris,

McCabe, Ricciardelli, Milgrom, & Baur, 2011). Fathers with permissive parenting styles and low control of child feeding practices are more likely to have a child with a higher BMI status (Wake, Nicholson, Hardy, & Smith, 2007). The extent to which fathers show warmth and support, also predicts better weight outcomes and maintenance of weight loss over time (Stein, Epstein, Raynor, Kilanowski, & Paluch, 2005). Furthermore, father-only interventions targeting lifestyle habits demonstrate significant decreases in father BMI and improvements in child lifestyle behaviour (Morgan et al., 2011; Morgan et al., 2013).

Fathers are less likely to attend parenting programs compared to mothers (Well, Sarkadi & Salari, 2016). A meta-analysis of the effectiveness of Triple P programs on parenting practices revealed significant improvements for both parents, although a smaller effect size was observed in fathers (Fletcher, Freeman, & Matthey, 2011). Fathers may attend parenting programs for different reasons to mothers (Bayley, Wallace & Choudhry, 2009; Frank, Keown, Dittman, & Sanders, 2015; Well, Sarkadi & Salari, 2016). Mothers were more likely to attend a universal Triple P parenting intervention if they perceived their child to have more behavioural problems, while fathers were more likely to attend if their child was perceived to have more emotional problems (Well, Sarkadi & Salari, 2016). This suggests that different factors may impact mothers' and fathers' attendance at parenting interventions. Future research should aim to identify the differences between mother and father attendance motivators to allow formulation of appropriate recruitment strategies. Specific engagement of fathers may then allow different delivery modes or level of intervention offered to suit the needs of the father. Future studies should also assess father outcome data to evaluate intervention effectiveness, and tailor interventions (if required).

Cost-effectiveness of obesity initiatives

Cost effectiveness of interventions in obesity initiatives is a central consideration for policy makers and service providers. This is particularly relevant in relation to population

level interventions. The assessment of cost effectiveness is difficult to perform given the multifactorial nature of the societal cost of childhood obesity. Most of the costs manifest in adult life, such as disease comorbidities and work productivity, which makes it difficult to estimate the impact of childhood interventions. Few evaluation trials have conducted cost assessments, other than to investigate the costs of delivering the intervention (Lobstein et al., 2015). Conducting in-depth cost analysis research on obesity interventions may strengthen the argument for policy makers.

Two existing economic analyses of the Triple P system have demonstrated cost-effectiveness through savings in child welfare system costs (Aos et al., 2014; Foster, Prinz, Sanders, & Shapiro, 2008). The relatively small cost of approximately \$12 per child in an American population trial was estimated to be recovered through reduced welfare costs (Foster, Prinz, Sanders, & Shapiro, 2008). The potential additional benefit of a lifestyle program may be achieved through the substantial savings in comorbidity and productivity resulting from reduced adult obesity rates.

Most Triple P cost effectiveness research has evaluated the more intensive group programs (Ward, Sanders, Gardner, Mikton, & Dawes, 2015). Future studies should focus on the cost effectiveness of the low intensity interventions, such as such as media campaigns, large group seminars, self-help and telephone-assisted and web-delivered programs, as they are likely to be more cost effective and may be particularly relevant to resource poor settings and time-poor families.

Parental engagement

The current body of research did not investigate the mechanisms involved in parental recruitment and retention. Research suggests that the attrition rates for lifestyle interventions for children are quite high, ranging from 49% to 73% (Skelton, Goff, Ip & Beech, 2011). Future investigators should conduct focus group research with parents from various

socioeconomic and cultural backgrounds to identify the barriers and enablers for accessing lifestyle-specific parenting programs. Future evaluation trials should also investigate predictors of attrition by performing mediator and moderator analyses in order to identify parent and child characteristics associated with attrition from obesity programs.

Future recommendations for clinicians

Engaging multiple settings

Community dissemination can be augmented by engagement in multiple settings. Schools, early childhood centres, sport/recreation clubs, and religious organisations are all potential targets for intervention promotion and implementation.

One potential obstacle can be a lack of an adequately trained workforce. Training and accreditation in Lifestyle Triple P does not require highly specialised expertise. Professionals from multiple disciplines are able to receive training in order to deliver the intervention with fidelity. Increasing the capacity of the public health workforce to manage the obesity epidemic is key to population-level change.

The general practitioner is generally considered the coordinator of primary care for families. There is substantial evidence that most are quite uncomfortable about discussing child weight issues with a parent (Wethington, Sherry, & Polhamus, 2011). Many report that they are not confident with subsequent management of childhood obesity (Gerards, Dangelie, Jansen, De Vries, & Kremers, 2012). In recruitment for the Lifestyle Triple P Seminar Series RCT (described in Chapter 3), general practitioners were approached extensively, however very few referrals were subsequently made. The large majority of enrolments came from childcare centres and schools. It would seem that the best strategy for implementation of a universal program would be to target schools and childcare centres, rather than general clinical practice alone. A short program such as the seminar series could easily be offered to all parents and potentially be delivered to substantial numbers within an educational context.

General practice may be an environment for case ascertainment and encourage parents to participate in interventions. A recent report in the American Academy of Pediatrics (2016) highlighted the importance of pediatric advocacy for parent education. It suggested that pediatricians and other pediatric health practitioners in a family-centered health context have the propensity to assess risk, link families to resources, and coordinate care with community partners.

Potential variants of Lifestyle Triple P

The flexibility of program format (e.g., group or individual) will make the intervention more accessible to parents and useful to a broad range of healthcare providers. Other variants of Triple P are currently offered in online-format, and have found beneficial effects on measures of problem child behavior, dysfunctional parenting styles, parental confidence in their parenting role, and parental anger (Sanders, Baker, & Turner, 2012). An online version of Lifestyle Triple P may facilitate the accessibility of the intervention to rural and remote communities with limited access to local services, which may augment a population-level approach. Logistical problems, such as work-schedule conflicts and childcare availability associated with attendance may also be addressed.

A lifestyle-specific adolescent parenting program could also be advantageous given the increase in adolescent obesity rates (described in Chapter 1). Teen Triple P is specifically designed to assist parents with teenagers aged 11-16 years. Research supports the efficacy of this intervention with decreased levels of disruptive behaviours, parent-adolescent conflict, ineffective parenting strategies and conflict over child rearing (Salari, Ralph & Sanders, 2014). An intervention, which blends the Lifestyle Triple P healthy living strategies with Teen Triple P, may help assist the obesity epidemic in the adolescent population.

Lifestyle Triple P Seminar Series is aimed at early childhood (age 2 to 12 years) when many child nutrition and activity habits are developing. It may be effective if delivered in the antenatal period when additional maternal health benefits could be achieved.

Implications for policy

Government policy at a statewide and national level has an integral role to play in shifting obesity rates and ensuring the sustainability of intervention effects. Australia needs a statewide and national policy for population-based parenting programs for childhood obesity.

Monitoring and feedback system

Few countries have established systems for regular monitoring of child height and weight. In Australia, there have only been two national surveys in the last decade, and they have not provided detailed data in relation to ethnicity, socio-economic status, or parenting behaviour. A more regular monitoring of prevalence and trend data is required. Indicators should include not only body measurements but also individual risk factors, such as parenting practices and child lifestyle behaviours. A brief, reliable measure that is sensitive to population-level changes can be performed as part of the National Health Survey and would be consistent with the goals of the National Preventative Health Taskforce. It could also offer a means of assessing parental feedback regarding challenges faced with raising their children, the type of support needed, and the motivating factors for program participation.

The practice of annual BMI checks on every child in a US state (Arkansas) involved parental feedback on child weight status in the form of a Health Card Report (Ryan, Card-Higginson, McCarthy, Justus, & Thompson, 2006; Denehy, 2004). Lawrence and Swinburn (1993) supported its benefits to the community, suggesting that it raised awareness and contributed to a plateau in the state obesity prevalence rates. The way in which feedback information is framed to parents needs to be considered to ensure healthy growth is emphasised rather than allowing a focus on weight gain which may lead to overly restrictive

parenting practices. This parental feedback should be complemented with the availability of services for families, such as Lifestyle Triple P.

Final Comment

The research reported in this thesis provides a framework for policy makers and government representatives in the prevention and treatment of childhood obesity. The Lifestyle Triple P multilevel system has the capacity to be delivered at a population level with wide parent reach. Its universality is derived from its multilevel functionality. The media campaign promotes widespread health messages and awareness of the need for healthy lifestyle practices. The universal seminars foster a healthy home environment for all families. The intensive intervention is available to target families with children who are already overweight or obese. Taken together these interventions provide a whole-of-population approach to the childhood obesity epidemic.

References

- American Academy of Pediatrics Council on Community Pediatrics. (2016). Poverty and Child Health in the United States. *Pediatrics*, 137, 1-14. doi: 10.1542/peds.2016-0339
- Bayley, J., Wallace, L. M., & Choudhry, K. (2009). Fathers and parenting programmes: Barriers and best practice. *Community Practice*, 82, 28-31.
- Fletcher, R., Freeman, E., & Matthey, S. (2011). The impact of behavioural parent training on fathers' parenting: A meta-analysis of the Triple P-Positive Parenting Program. *Fathering*, 9, 291-312. doi: 10.3149/fth.0903.291
- Frank, T. J., Keown, L. J., Dittman, C. K., & Sanders, M. R. (2015). Using father preference data to increase father engagement in evidence-based parenting programs. *Journal of Child & Family Studies*, 24, 937-947. doi: 10.1007/s10826-014-9904-9
- Fraser, J., Skouteris, H., McCabe, M., Ricciardelli, L. A., Milgrom, J., & Baur, L. A. (2011). Paternal influences on children's weight gain: a systematic review. *Fathering*, 9, 252-267. doi: 10.3149/fth.0903.252
- Freedman, D. S., Khan, L. K., Dietz, W. H., Srinivasan, S. R., & Berenson, G. S. (2001). Relationship of childhood obesity to coronary heart disease risk factors in adulthood: The Bogalusa Heart Study. *Pediatrics*, 108, 712-718.
- Gerards, S. M. P. L., Dagnelie, P. C., Jansen, M. W. J., De Vries, N. K., & Kremers, S. P. J. (2012). Barriers to successful recruitment of parents of overweight children for an obesity prevention intervention: a qualitative study among health care professionals. *BMC Family Practice*, 13, 37. doi: 10.1186/1471-2296-13-37.
- Hardy, L. L., King, L., Espinel, P., Cosgrove, C., & Bauman, A. (2011). *NSW Schools Physical Activity and Nutrition Survey (SPANS) 2010: Full Report*. Ministry of Health: Canberra, ACT.

- Lobstein, T., Jackson-Leach, R., Moodie, M. L., Hall, K. D., Gortmaker, S. L., ... & McPherson, K. (2015). Child and adolescent obesity: part of a bigger picture. *Lancet*, 385, 2510-2520. doi: 10.1016/S0140-6736(14)61746-3
- Molnar, B. E., Gortmaker, S. L., Bull, F. C., & Buka, S. L. (2004). Unsafe to play? Neighbourhood disorder and lack of safety predict reduced physical activity among urban children and adolescents. *American Journal of Health Promotion*, 18, 378-386.
- Morgan, P. J., Lubans, D. R., Callister, R. C., Okely, A. D., Burrows, T. L., Fletcher, R., & Collins, C. E. The 'Healthy Dads, Healthy Kids' randomized controlled trial: efficacy of a healthy lifestyle program for overweight fathers and their children. *International Journal of Obesity*, 35, 436-447. doi: 10.1038/ijo.2010.151.
- Morgan, P. J., Collins, C. E., Plotnikoff, R. C., Callister, R., Burrows, T., ... & Lubans, D. R. (2013). The 'Healthy Dads, Healthy Kids' community randomized controlled trial: A community-based healthy lifestyle program for fathers and their children. *Preventative Medicine*, 61, 90-99. doi: 10.1016/j.ypmed.2013.12.019.
- Ryan, K. W., Card-Higginson, P., McCarthy, S. G., Justus, M. B., & Thompson, J. W. (2006). Arkansas fights fat: translating research into policy to combat childhood and adolescent obesity. *Health Affairs*, 25, 992-1004.
- Salari, R., Ralph, A., & Sanders, M. R. (2014). An efficacy trial: Positive Parenting Program for Parents of Teenagers. *Behaviour Change*, 31, 34-52. doi: 10.1017/bec.2013.31
- Sanders, M. R., Sabine, B., & Turner, K. M. T. (2012). Randomized controlled trial evaluating the efficacy of Triple P Online with parents of children with early-onset conduct problems. *Behaviour Research and Therapy*, 50, 675-684. doi: 10.1016/j.brat.2012.07.004

- Skelton, J. A., Goff, D. C., Ip, E., & Beech, B. M. (2011). Attrition in a multidisciplinary pediatric weight management clinic. *Childhood Obesity*, 7, 185-193. doi: 10.1089/chi.2011.0010.
- Stein, R., Epstein, L., Raynor, H., Kilanowski, C., & Paluch, R. (2005). The influence of parenting change on pediatric weight control. *Obesity*, 13, 1749-1755. doi: 10.1038/oby.2005.213
- Telford, A., Salmon, J., Jolley, D., & Crawford, D. (2004). Reliability and validity of physical activity questionnaires for children: The Children's Leisure Activities Study Survey (CLASS). *Pediatric Exercise Science*, 16, 64-78.
- Vereecken, C. A., Keukelier, E., & Maes, L. (2004). Influence of mother's educational level on food parenting practices and food habits of young children. *Appetite*, 43, 93-103. doi: 10.1016/j.appet.2004.04.002
- Wake, M., Nicholson, J. M., Hardy, P., & Smith, K. (2007). Preschooler obesity and parenting styles of mothers and fathers: Australian national population study. *Pediatrics*, 120, e1520-1527.
- Ward, C., Sanders, M. R., Gardner, F., Mikton, C., & Dawes, A. (2016). Preventing child maltreatment in low- and middle-income countries: parent support programs have the potential to buffer the effects of poverty. *Child Abuse & Neglect*, 54, 97-107. doi: 10.1016/j.chiabu.2015.11.002
- Wells, M. B., Sarkadi, A., & Salari, R. (2016). Mothers' and fathers' attendance in a community-based universally offered parenting program in Sweden. *Scandinavian Journal of Public Health*, 44, 274-280. doi: 10.1177/1403494815618841
- Wethington, H. R., Sherry, B., Polhamus, B. (2011). Physician practices related to use of BMI-for-age and counseling for childhood obesity prevention: A cross-sectional study. *BMC Family Practice*, 12, 80. doi: 10.1186/1471-2296-12-80.

Wilkin, T. J., Mallam, K. M., Metcalf, B. S., Jeffery, A. N., & Voss, L. D. (2006). Variation in physical activity lies with the child, not his environment: evidence for an “activitystat” in young children. *International Journal of Obesity*, 30, 1050-1055. doi: 10.1038/sj.ijo.0803331